TECHNICAL DEPT.
FEB 1
DETROIT

Construction Methods

McGraw-Hill Publishing Company, Inc.

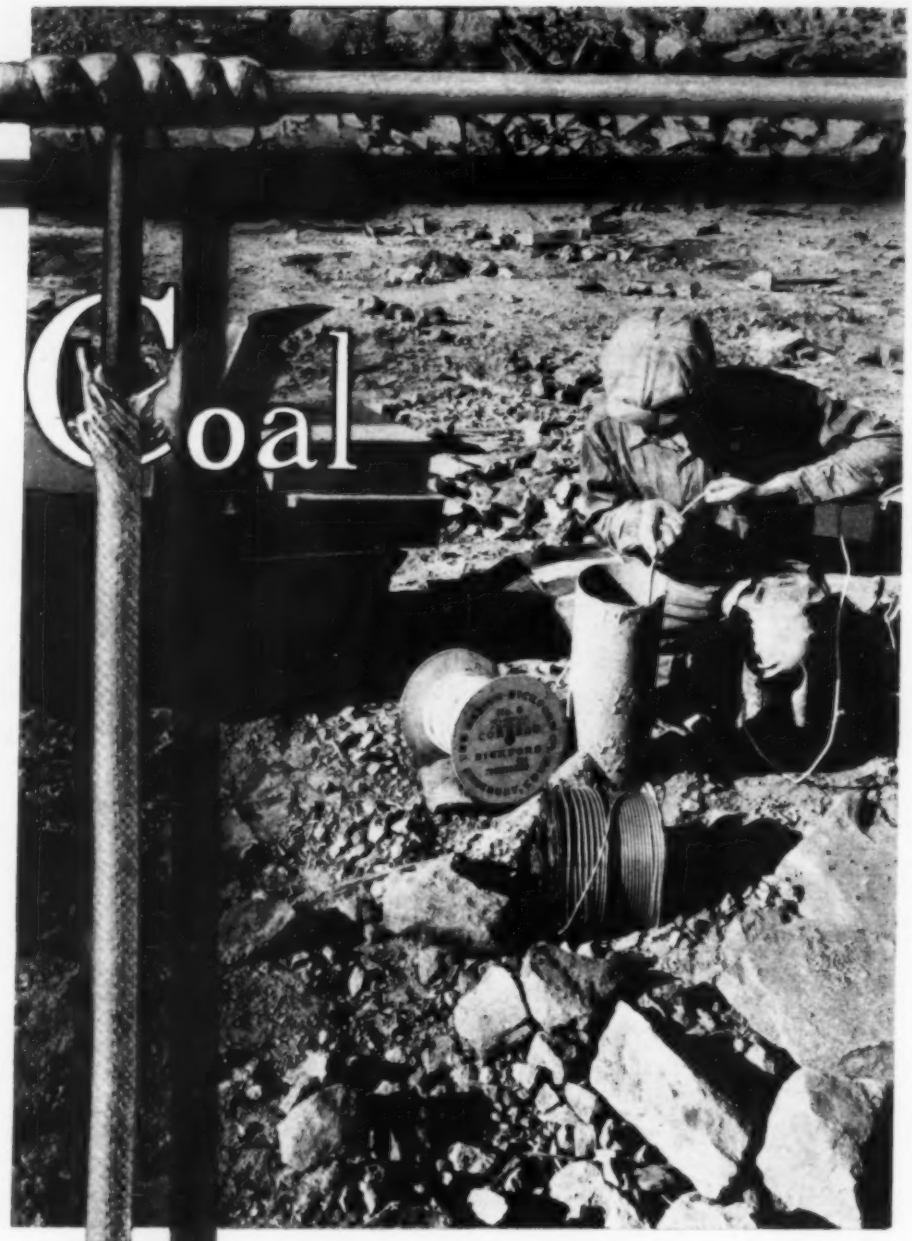
February, 1936

Price 20 Cents

5 YARDS AT A BITE. Big dragline dumps bucketful of spoil from excavation along line of Colorado River aqueduct in California.

Photo, Metro

Stripping *with* CORDEAU BICKFORD *at the* Lehigh Navigation Coal Company



In the strip pit one mile long and 1,500 feet wide, an average of 10,000 cu. yds. of rock overburden is blasted and removed every twenty-four hours. The Mammoth anthracite vein, pitched at 45°, is from 40 to 125 feet thick and yields an average of 3,000 tons of coal during this period.

Here is a production cycle that allows little time for fancy juggling with steam shovels, or mud capping to obtain proper fragmentation. The overburden is an "overhead" that must be removed as quickly and easily as possible.

Cordeau-Bickford Detonating Fuse is used throughout these stripping operations because *it pays in five ways:* (1) *Simplified Loading* — no caps in the holes. (2) *Less Hazard* — Cordeau is insensitive to ordinary shocks. It must be detonated in order to detonate the loads. (3) *More Work from Explosives*—each cartridge, being detonated directly by the Cordeau, has the added force of a *primer* cartridge. (4) *Fewer but Bigger Shots* — Cordeau not only detonates each hole but connects all holes, producing the Giant Blast. Equipment moved less often. (5) *Better Fragmentation* — planned rotation secured with a Cordeau hook-up permits relief of burden, and allows each charge to exert its force to the best advantage.

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The ENSIGN-BICKFORD COMPANY, Simsbury, Conn.

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TECHNOLOGY DEPT

Construction Methods

McGraw-Hill Publishing Company, Inc.
330 West 42nd St., New York

ROBERT K. TOMLIN, Editor

FEBRUARY, 1936

WILLARD CHEVALIER, Vice-President

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Current Jobs AND WHO'S DOING THEM

With this issue "Construction Methods" inaugurates a monthly department of notes on recent contract awards and progress of important construction projects:

Two More TVA Dams

Notable among major heavy construction projects which have lately gotten under way are two more big dams—Guntersville and Chicamauga—for the Tennessee Valley Authority of Knoxville, Tenn., to be built by the Authority (*Arthur E. Morgan*, chief engineer) with its own forces in the same way that Norris, Wheeler and Pickwick Landing dams, now under construction, are being handled. Chicamauga dam, on the Tennessee River 7 miles above Chattanooga, consisting of a concrete spillway flanked by earth-fill sections and navigation lock, is estimated to cost about $32,000,000. It has a length of 5,685 ft., a maximum height of 104 ft.; as construction engineer, *Lee G. Warren* will be in charge of the project. Guntersville dam, on the Tennessee River in Alabama, including two earth-fill sctions of 1,000 and 1,300 ft., 1,240-ft. concrete spillway 80 ft. high, power-house and lock, will involve a construction cost of about $29,000,000; *Verne Gongwer* has been assigned to this project as engineer of construction.

Mountain Highway

For the construction of a portion of the great scenic highway constituting the Shenandoah - Great Smoky Mountain Parkway the Virginia State Highway Department, in December, awarded a group of six contracts aggregating $1,140,710, all involving 8 to 11-mi. lengths of heavy grading along mountainous routes. The successful contractors, with the amounts of their bids, were: *C. A. Ragland*, Louisburg, N. C. ($213,567 for 9.2 mi.); *C. A. Vilbig*, Dallas Tex. ($234,676 for 9.0 mi.); *W. W. Tuck & Sons*, Virgilina, Va. ($215,313 for 9.7 mi.); *E. W. Grannis*, Fayetteville, N. C. ($219,913 for 8.2 mi.); *R. E. Mills*, Frankfort, Ky. ($322,866 for 8.4 mi.); *T. M. Strider & Co.*, Nashville, Tenn. ($204,375 for 11.0 mi.)

School Buildings

There has been marked activity of late in the field of school and college building construction. Reports indicate that this development is country-wide rather than confined to any sectional area. Recent awards for school construction have been made to general contractors for projects in the following cities: Columbia, Mo., $715,588, *Dickey Construction Co.*, St. Louis, Mo.; Tucson, Ariz., $553,434, *Sundt Construction Co.*, Tucson; Ramsey, N. J., $466,660, *H. Montague & Son*, Jersey City; Detroit, Mich., $886,848, *Rozyski Bros.*, Detroit; Cleveland, Ohio, $447,800, *Hunkin-Conkey Construction Co.*, Cleveland; Providence, R. I., $1,333,391, *Tucker Construction Co.* and *C. T. Wills*, Providence; Paterson, N. J., $530,807, *E. M. Waldron, Inc.*, Newark; Watervliet, N. Y., $714,000, *J. J. Turner & Sons, Inc.*, Amsterdam, N. Y.; Westerly, R. I., $405,229, *Mondelci & Benvenuti*, New London, Conn.

How— . . IN THIS ISSUE ARTICLES AND ILLUSTRATIONS TELL:

How . . . H-SECTION STEEL PILES were driven for foundation of industrial building —(p. 28)

How . . . LOAD-BEARING TESTS were made on job to predetermine performance of steel piles. —(p. 32)

How . . . PUMP-HANDLE JACKING device extracted steel test rods driven to refusal. —(p. 29)

How . . . BELT CONVEYORS delivered transit-mixed concrete to large mat foundations. —(p. 30)

How . . . BOTTOM-DUMP BUCKETS were rigged with semi-circular gates to control flow of concrete into forms —(p. 32)

How . . . PUMPED CONCRETE was delivered through pipeline to raise spillway of dam. —(p. 38)

How . . . PLUGGED LENGTHS of concrete-conveying pipe line were quickly cleaned out. —(p. 40)

How . . . CONCRETE PUMP was supported by brackets and steel straps on sloping face of dam. —(p. 39)

How . . . THIRTEEN-STORY BUILDING was cut in two and set back 5 ft. to widen street. —(p. 33)

How . . . TRANSLUCENT GLASS blocks were laid up like brick to form office partitions. —(p. 42)

How . . . PENETRATION NEEDLE indicated proper compaction for earth fill. —(p. 42)

How . . . BRIDGE STEEL was erected by special floating tower derrick. —(p. 43)

How . . . "PORTCULLIS" of steel sheeting was dropped into swift current to make cofferdam closure. —(p. 43)

How . . . CANVAS TENT covered big floor slab area for winter concreting. —(p. 43)

How . . . CRANE on flanged-wheel truck laid railway track on bridge. —(p. 25)

How . . . FLOATING PILEDRIVER built wood trestle in swift current 60 ft. deep. —(p. 34)

How . . . TENSION CABLE from barge spotted piles for driving in raging river. —(p. 35)

How . . . ERECTION of 15-ft. diameter multi-plate waterway was handled. —(p. 41)

Current Jobs AND WHO'S DOING THEM

Colorado River Aqueduct

On the 242-mi. aqueduct project to deliver Colorado River water from an intake at Parker dam, below Boulder dam, to a distribution reservoir in Los Angeles recent awards have been to the *American Concrete & Steel Pipe Co.*, Southgate, Calif., for 5 mi. of 11-ft. 8-in. precast concrete pipe line at $1,421,251; to the *Western Pipe & Steel Co.*, Los Angeles, for 10½ mi. of 9 ft. 8 in. to 12-ft. steel conduit at $4,047,374; and to the *J. F. Shea Co.*, Mecca, Calif., for 10.8 mi. of 11-ft. 8-in. diameter precast concrete pipe for distribution system at $2,319,462.

On Jan. 2, the 18.3-mi. East Coachella tunnel, longest bore of its diameter in the world (16 ft. inside concrete lining) was holed through after three years of steady labor by forces of the Metropolitan Water District of Southern California, under *B. C. Leadbetter*, general superintendent.

Industrial Buildings

Several important industrial building projects have been placed under contract during recent weeks. At Beaumont, Tex., a refinery structure for the Atlantic Refining Co., costing $1,500,000, has been let to *M. W. Kellogg Co.*, of New York; total cost of project will run to about $3,000,000. For the General Dyestuffs Corp., New York City, *Willton Construction Co.* has started work on a 9-story brick and steel building to cost at least $1,500,000. Plant improvements for the U. S. Pipe & Foundry Co., at Chattanooga, Tenn., are in progress under a $600,000 contract with *United Engineers & Constructors*, New York City.

Waterworks and Sewerage

At Pittsburgh, Pa., *Harrison Construction Co.*, of Pittsburgh, has received a $1,046,551 contract for a park lake and dam. In the same city *John Carson & Co.*, Pittsburgh, has started a $503,357 swimming pool job. At Cincinnati, Ohio, *Penker Construction Co.*, Cincinnati, is at work on a $942,517 chemical building and coagulating basins. Contracts for intercepting sewer in open cut and tunnel, totaling $1,849,666, have been awarded to *M. Pontarelli*, Chicago ($997,653); *S. A. Healy Construction Co.*, Chicago ($476,052); and to *John Marsh, Inc.*, Chicago ($321,961). With its own forces at Syracuse, N. Y., Onondaga County has started work on a $2,000,000 sewage disposal plant.

Irrigation and Drainage

Bull Lake dam at Riverton, Wyo., a U. S. Bureau of Reclamation project, has been started by *J. S. Groves & Sons Co.*, of Minneapolis, under a $653,397 contract. On the same project *Utah Construction Co.* of Ogden, Utah, has a $614,509 tunnel job. Similar tunnels on the Roza project near Yakima, Washington, are under construction by *Morrison-Knudsen Co.*, Boise, Idaho, at a price of $993,839. In Texas, at Eagle Pass, the *Hardwick Construction Co.*, of Memphis, Tenn., is at work excavating irrigation canals for the Maverick County Water Control & Improvement District under a $1,474,676 contract.

On Choosing a Partner

IN considering the well-being of the construction industry no problem bobs up more consistently than that of the "irresponsible bidder." Many persistent every-day evils may be traced to this basic source; to it every organized group of responsible contractors must devote much of its attention and effort.

The problem is complicated by the fact that to the layman the term "responsibility" too often means nothing more than financial responsibility. Moreover, buyers of construction service are prone to think only of price and are too willing to award their work to a low-bidder regardless of other values.

But those who have learned the high cost of incompetent management, inferior workmanship, avoidable extras, excessive inspection, demoralizing delays and of constant controversy, buck-passing and litigation know that the ultimate cost to an owner may be something quite different from the figure on which the contract was awarded. That is the reason for the increasing emphasis during recent years on prequalification and on full information as to the performance records of bidders. This is but a recognition that, in construction, "responsibility" means far more than mere financial resources: the more widely this recognition prevails, the more rapid will be our progress in dealing with the evils that beset this highly individual and competitive industry.

RECENTLY this writer enjoyed an opportunity to learn the views of a middle-western banker who has had considerable experience with loans to contractors. It is interesting to observe the basis on which this man of finance appraises his risks. To him financial resources are but a part of the picture; first of all he is interested in whether or not his client has the "ability, character and equipment" to do a given job without endangering the funds of the bank.

Getting down to details, this banker puts each loan to these tests:

1. Is the contractor competent to handle the job at hand?
2. Does he have the equipment to carry it out?
3. Does he have sufficient working capital to absorb any reasonable loss?
4. Is his character such that if he gets into trouble or finds that his calculations were seriously inaccurate, he will frankly and quickly admit it to the bank so that together they can work out of the difficulties; or will he try to cover them up? A good moral risk is absolutely essential.
5. Was adequate profit figured on the work?
6. Were the bids close or was the successful bidder much lower than his competitors?
7. Were those competitors who bid higher than he did experienced in the work?

It might be thought that because the banker becomes in a sense the partner of his client, he has special reasons for so penetrating an inquiry into the character, competence, equipment and other resources of the contractor. But is he in fact as much of a partner as are the owners or awarding authorities for whom the work is to be done? After all, he is involved only to the amount of his loan and his interest charges. But the owner is involved to the full first cost of his project, plus the costs of delayed completion, excessive maintenance or operation and of any failure that might affect adversely its life or earning power.

WHEN a man buys a ready-made automobile he may feel little sense of partnership with its maker. But it is quite another matter to entrust to a contractor the construction of a project that involves the fixing of capital through exacting technical processes that must be carried on over a protracted period, subject to the many hazards of inefficient organization, incompetent supervision, labor troubles, unpredictable weather and other natural conditions, major accidents, delayed deliveries or the deliberate scamping of workmanship and substitution of inferior materials in order to make up for an excessively low bid.

Surely here is a partnership into which any owner should be reluctant to enter without ample assurance as to the character, competence and equipment of the man to whom he thus entrusts the security of his capital. Doubtless, in this very human world, we shall always have with us the irresponsible bidder; but when more buyers of construction service recognize this relationship and apply the tests used by this banker we shall make real progress toward curbing the power of the irresponsibles to play havoc with the construction industry.

Willard Chevalier

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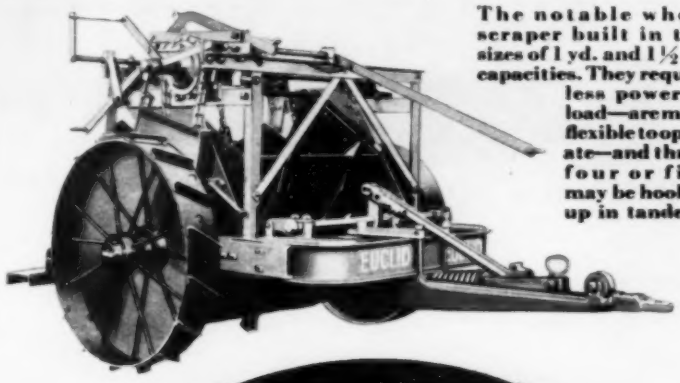
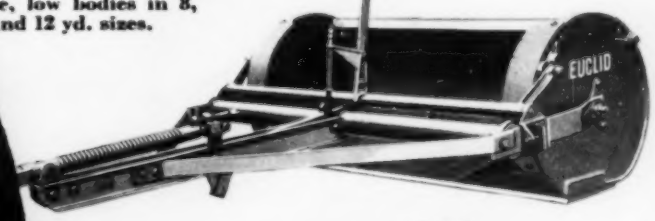


The notable wheel scraper built in two sizes of 1 yd. and 1½ yd. capacities. They require less power to load—are more flexible to operate—and three, four or five may be hooked up in tandem.

Bottom Dump Wagon mounted on crawler tracks or pneumatic tired wheels. Long, wide, low bodies in 8, 11 and 12 yd. sizes.

This rugged rotary scraper is furnished in a complete line of sizes, ranging from 18 to 56 cu. ft. capacity.



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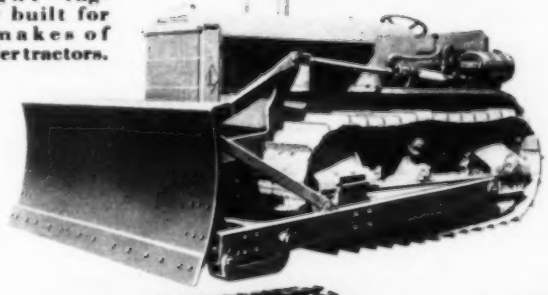
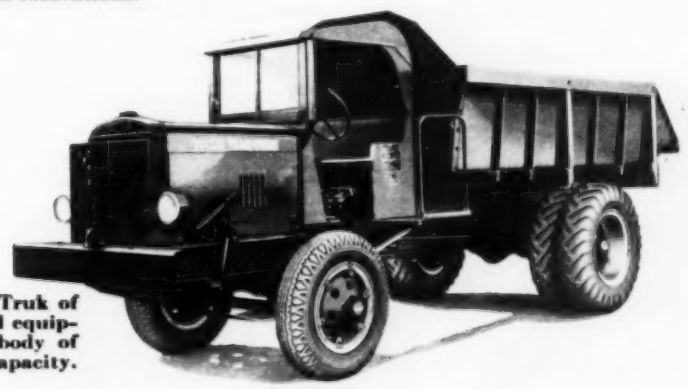
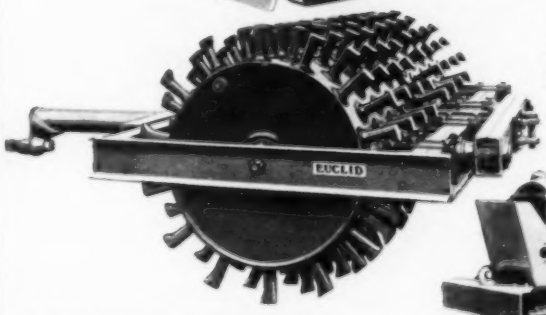
Bulldozers with minimum dead-weight—ruggedly built for all makes of crawler tractors.

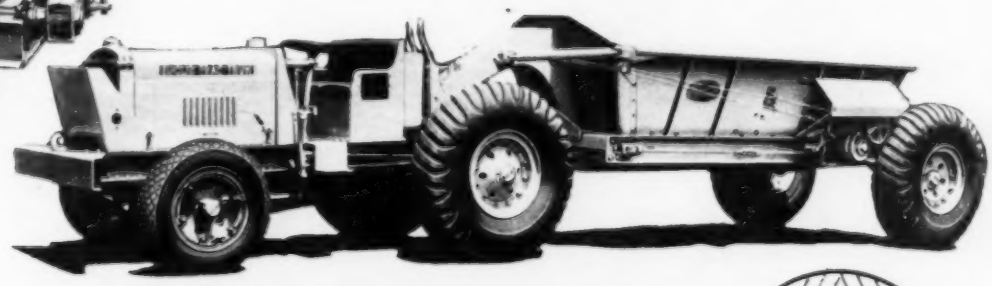




Rear Dump Trac-Truk of ten ton rating and equipped with sturdy body of 7 yd. water level capacity.



A double section, oscillating type tamping roller that includes cleaning combs and rear hitch as standard equipment.



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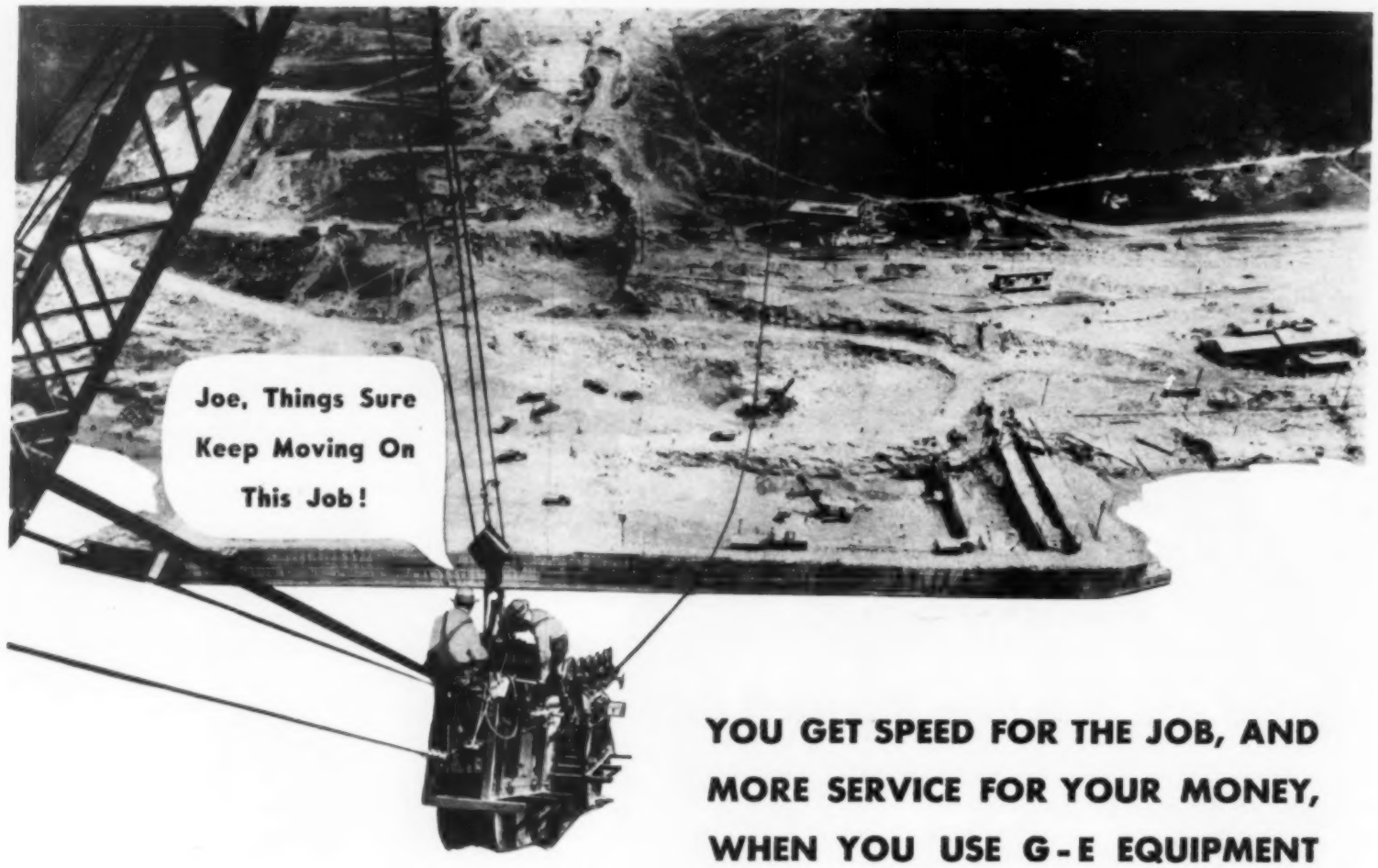

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GENERAL ELECTRIC

SEWAGE PROBLEM SOLVED FOR A GENERATION

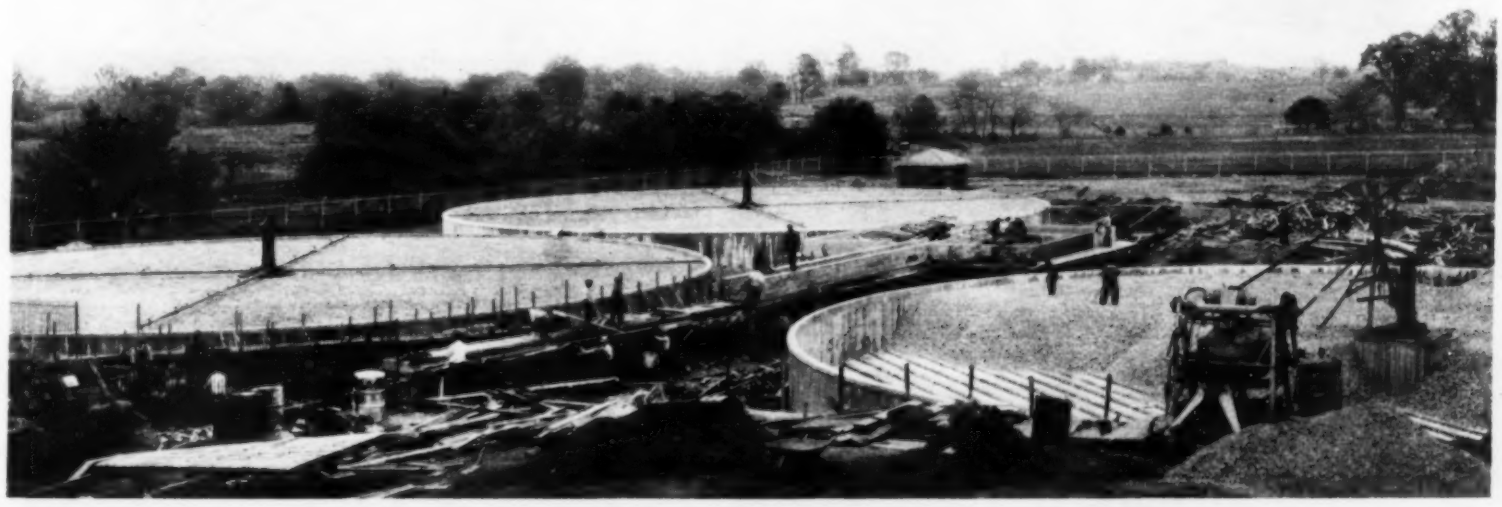
New Double-Capacity Plant Built Without Interrupting Service

CARLISLE, PA., outgrew its old sewage-disposal plant. City officials decided to solve the problem for a generation. Prof. Elton D. Walker, Dean of Civil Engineering, Pennsylvania State College, surveyed modern disposal plants, studied materials and methods—then designed a plant adequate for a city of 28,000, twice Carlisle's present size. 'Incor' Cement was specified to (1) save forms, (2) reduce cold-weather hazard, (3) avoid interrupting service of old plant, (4) provide strong, dense, uniform concrete that withstands chemical action of sewage.

PWA funds were used. Borough Manager George P. Searight supervised the job, all done with local labor. By careful planning, the old plant remained in operation. 'Incor' speeded construction—there was no break in service. The photograph below shows three 120-ft. 'Incor' concrete filtration beds.

By curing 5 times as fast as ordinary concrete, 'Incor' minimized freezing hazard, reduced form costs and overhead, took the curing time-lag out of the job—and also made better concrete, because: The best concrete is that which cures thoroughly in the short time it is possible to keep it wet. With ordinary concrete that means 10 days—too long for most jobs. 'Incor' combines with water 5 times as fast, cures watertight in 48 hours—a big help in producing stronger, denser, more watertight concrete. 'Incor'* is made and sold by producers of Lone Star Cement, subsidiaries of International Cement Corporation, New York; also sold by other leading cement manufacturers.

*Reg. U. S. Pat. Off.



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FIRST—AND WHY!

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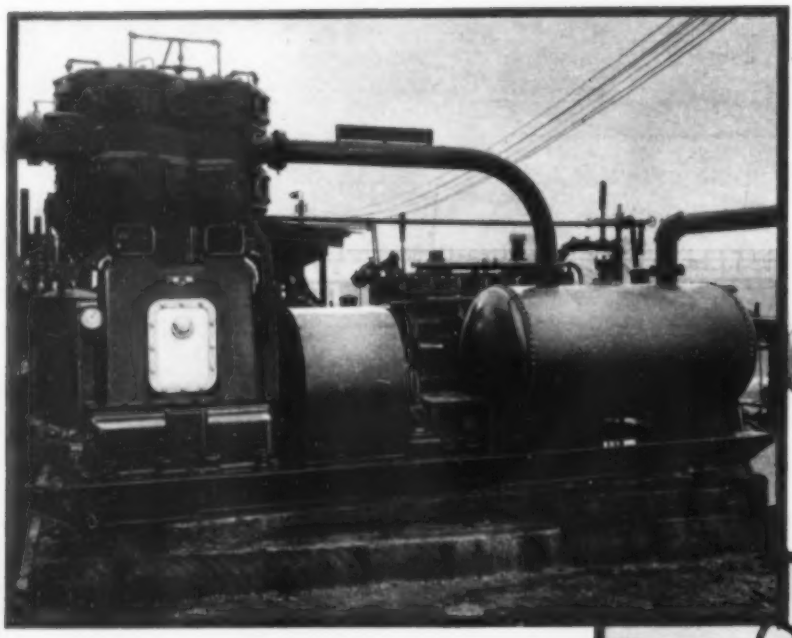

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profit

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ANY ONE OF ITS

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WOULD MAKE IT AN OUTSTANDING **BUY**

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● Any of these features is important. In one machine they combine to make the Austin-Western "77" Senior Motor Grader an all purpose machine for maintenance, pulling ditches, oil mix, scarifying, snow plowing, subgrading—a machine that has power, traction, and stability to do all of these jobs and more.

The points listed are outstanding mechanical features, yet the entire machine is built to produce results at the blade faster and more economically than competitive equipment.

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1. Powerful Diesel or gasoline motor.
2. 6 forward and 2 reverse speeds.
3. Floating drive—solid steel housing relieves the drive shaft of all weight and operating stresses.
4. Dual (8 tire) drive. Power on all drive wheels provides real traction.
5. Wide front axle with leaning wheels—prevents side slip—permits working in ditches.
6. Effective anti-chatter device—holds blade as in a vise.
7. Hydraulic controls—instant response for every operation from steering to reversing the circle.
8. Arc welded steel frame—weight is concentrated over the blade.

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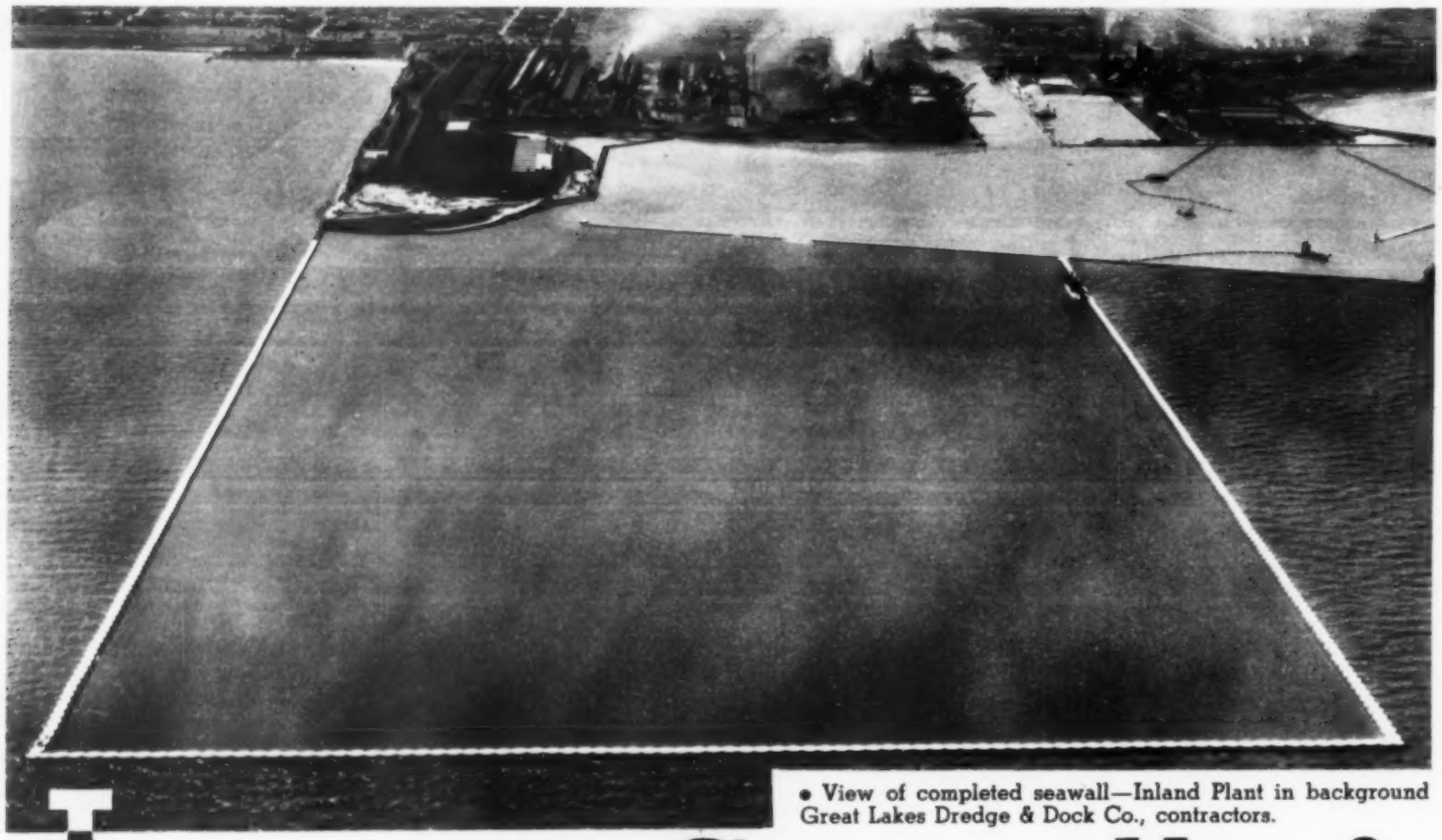


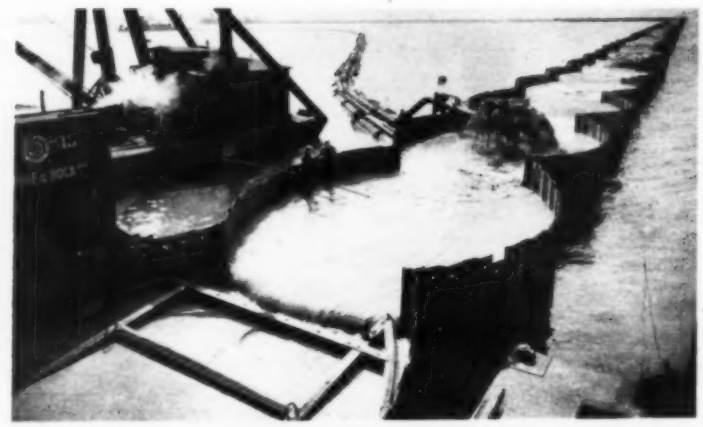
• View of completed seawall—Inland Plant in background
Great Lakes Dredge & Dock Co., contractors.

Longest Seawall of Inland Piling

Thrown out in a huge rectangle—over 2 miles in length—the longest seawall of cellular sand-filled type in the country now shields the Government Ship Canal and the Inland Steel Company's plant at Indiana Harbor, Indiana.

It is of a type new on the Great Lakes. Over 11,000 tons of Inland Sheet Piling (Section No. I-23) were used in constructing the cells, which were then filled with sand dredged from the lake. The structure is capped with 9 inches of concrete completing a seawall of great strength and durability.

We have much experience in the making and installation of steel sheet piling and will be pleased to work with you whenever you have a job of this kind. INLAND STEEL COMPANY, 38 S. Dearborn St., Chicago, Ill.



• Above: Seawall being filled with sand pumped from the lake bottom. Below: Closeup of finished seawall after being capped with 9 inches of concrete.

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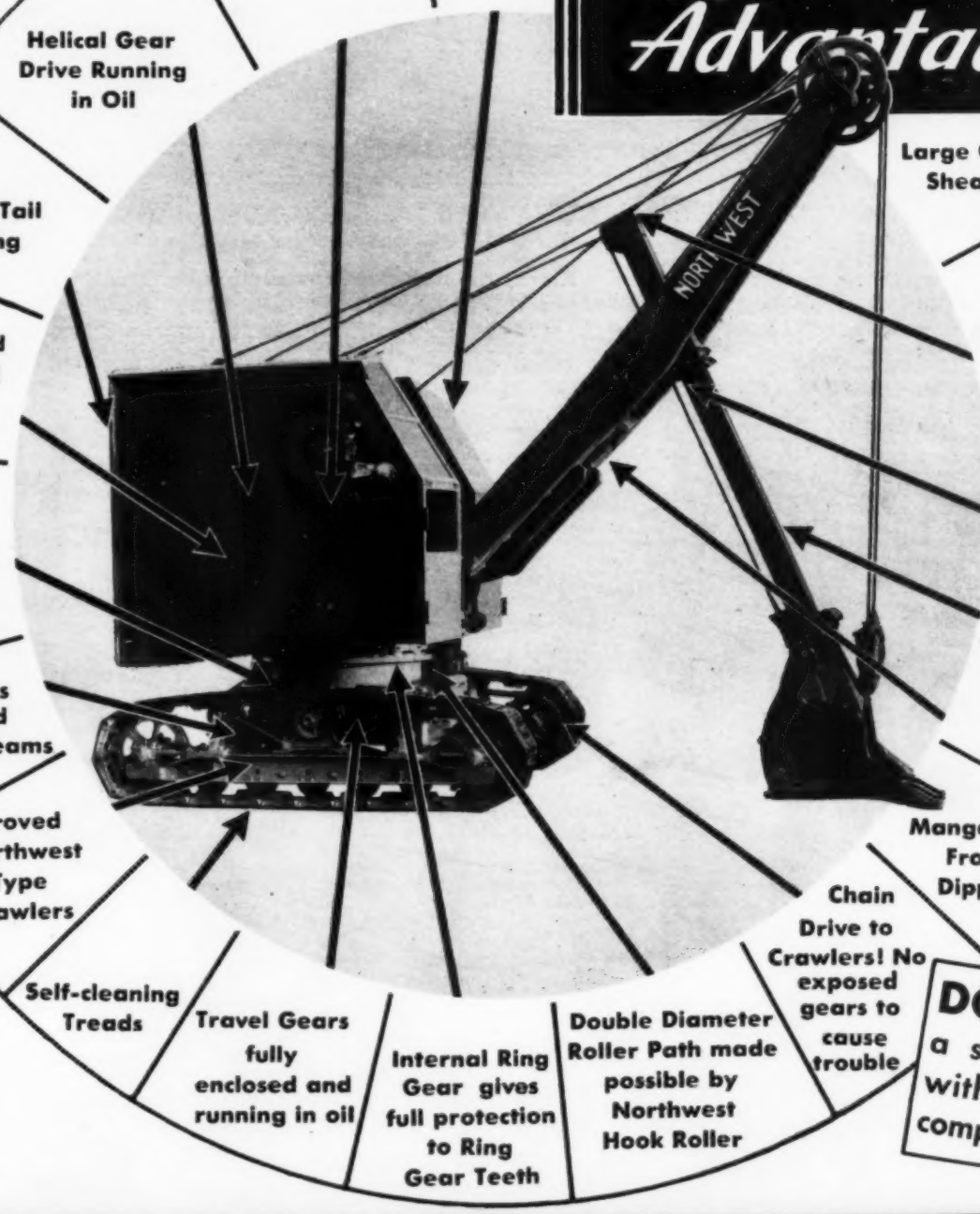

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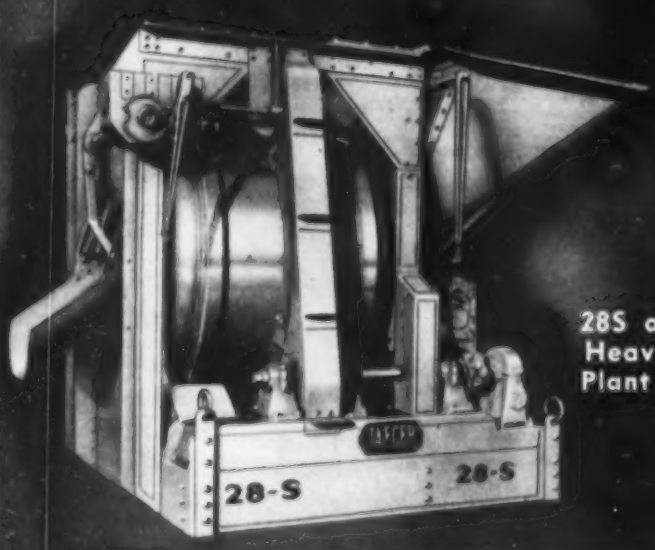
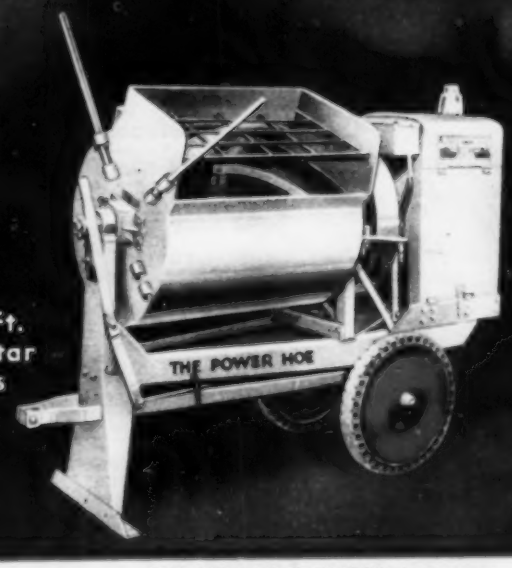


28S and 56S Heavy Duty Plant Mixers



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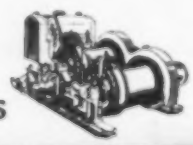

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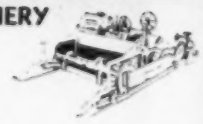

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PROOF OF PROFITABLE OPERATION LE TOURNEAU FLEET USERS

The best testimonial, we believe, to the profitable earth-moving of LE TOURNEAU equipment is the fact that so many successful contractors are LE TOURNEAU fleet users. More than 100 now operate three or more LE TOURNEAU units — and they all started with one on trial. Here are a few of them, selected to show that LE TOURNEAU equipment operates profitably the country over:

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L. Coluccio & Co.	Seattle, Washington
Dunn & Baker	Klamath Falls, Oregon
S. E. Evans	Van Buren, Arkansas
Benjamin Foster Co.	Philadelphia, Pa.
Grace Bros.	Honolulu Ter., Hawaii
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S. J. Groves & Sons Co.	Gardiner, Montana
C. V. Hallenbeck	Denver, Colorado
Isbell Construction Co.	Reno, Nevada
Peter Kiewit Sons Co.	Omaha, Nebraska
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Tennessee Valley Authority	Iuka, Mississippi
Winston Bros.	Minneapolis, Minn.

The experience of these users proves that LE TOURNEAU equipment moves more yardage quicker and at less cost. Talk to them; they are our best salesmen. Visit their jobs; see for yourself what LE TOURNEAU equipment is doing.

Working in Sierra National Forest. One of many LE TOURNEAU units owned by the U. S. Government.

Edward H. Ellis, Westville, New Jersey, is using seven CARRY-ALLS and one Bulldozer on the Chesapeake-Delaware Canal.

Part of Crow Brothers fleet moving earth on Stevens Creek Dam, Santa Clara Valley Water Conservation District project.

Peter Kiewit, Nebraska, working a fleet of nine CARRYALLS on a big power project.

Fleet of LE TOURNEAU CARRYALLS rebuilding Buffalo Bill's trail for Taggart Construction Company.

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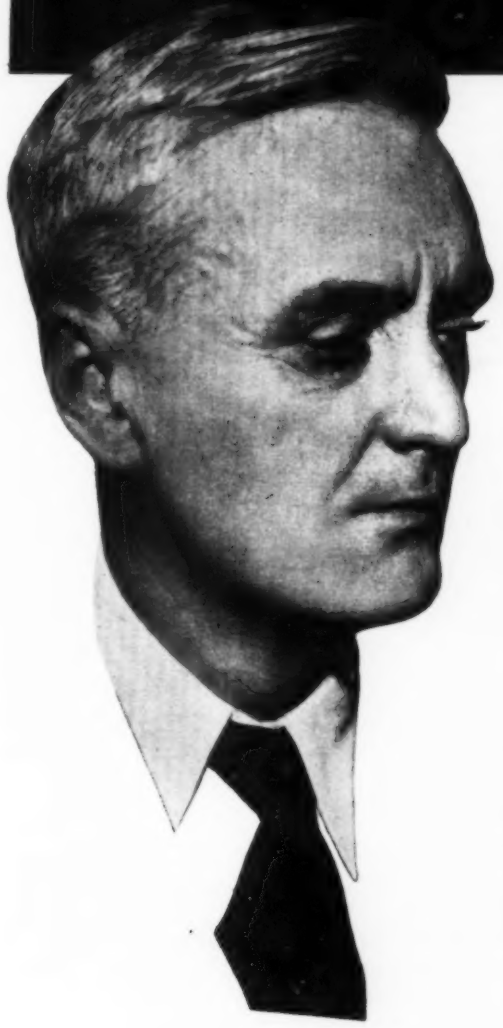
It Cost Too Much *to use the old stuff!*



4 Rex Moto-Mixers in one day, two eight-hour shifts mixed and delivered 1,048 yards of concrete to three separated points over a mile radius on the New York Central track elevation at Syracuse, N. Y.

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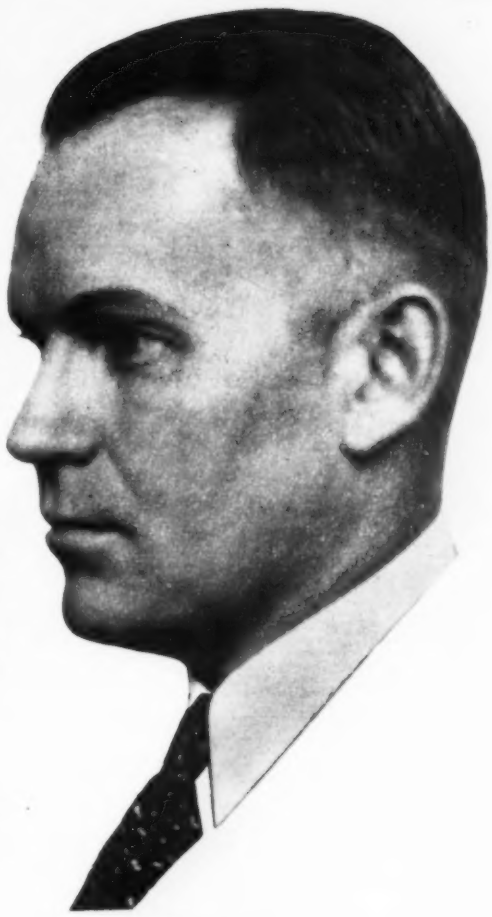
They'll tell you, too, that on this job, it paid to forget the *old stuff*.

Equipment that is already owned, methods of the years before, are often the load that shoots up cost and slows down the job.

In 1936, before you buy, before you bid, investigate the Up-To-Date Methods of Handling Concrete.



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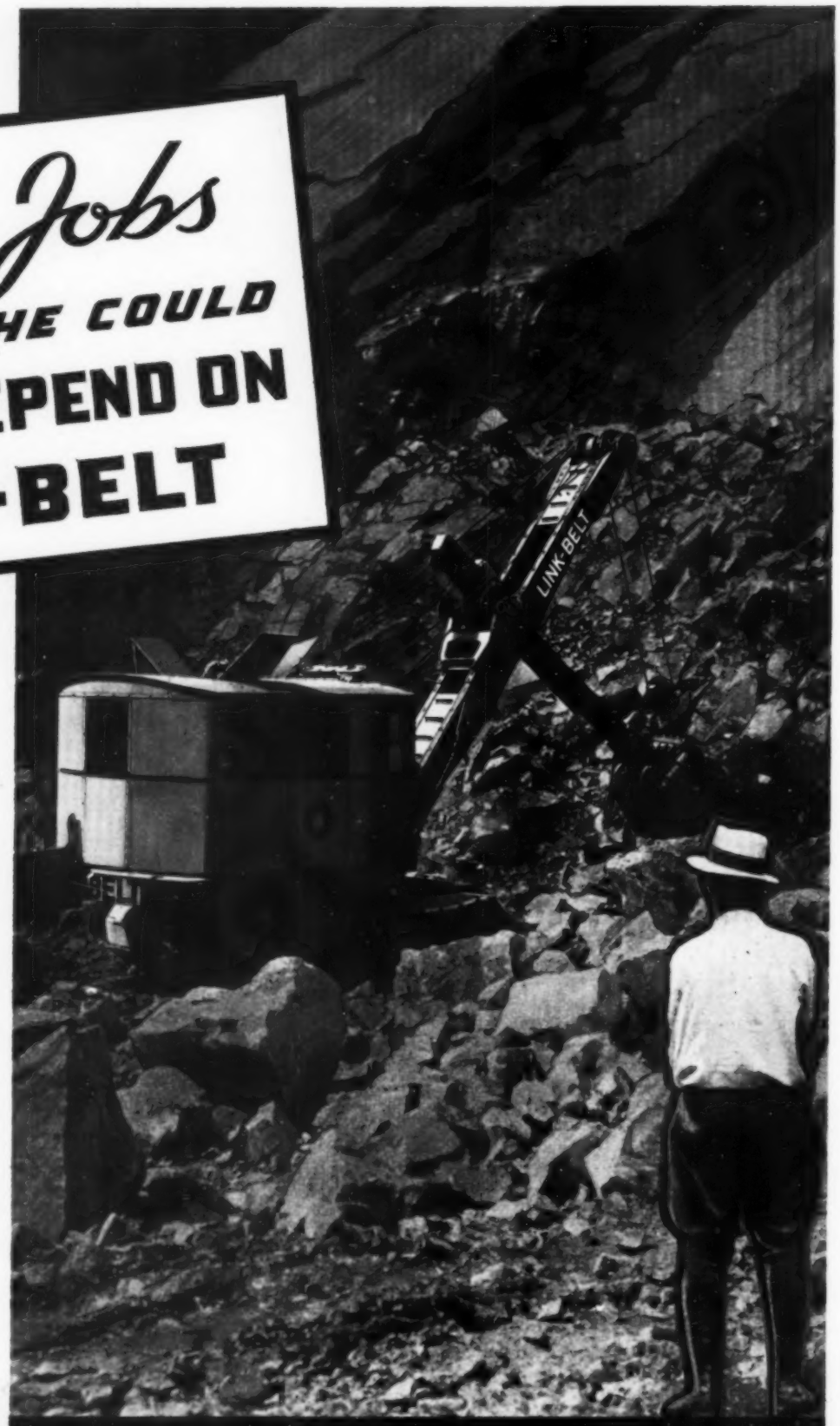

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UNIVERSAL ATLAS CEMENT

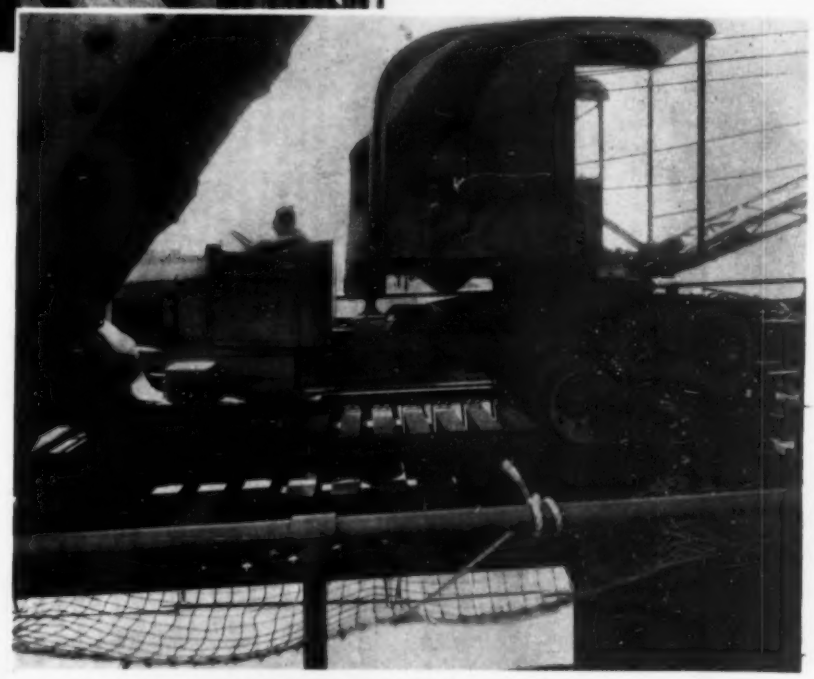
US STEEL

Construction Methods

ROBERT K. TOMLIN, Editor

Established 1919—McGraw-Hill Publishing Company, Inc. Volume 18—Number 2—New York, February, 1936

TRUCK CRANE *(left)* with 35-ft. boom, on flanged-wheel mounting, transfers timber ties from trailer car to bridge stringers in front of track-laying equipment.



DETAIL OF FLANGED-WHEEL MOUNTING for truck crane, with safety net stretched beside track to protect workers.

BRIDGE TRACK

Laid by Truck Crane on Flanged Wheels

TO LAY TIMBER TIES and steel rails for the Philadelphia-Camden High-Speed Transit Line on track spaces (provided in the original design) outside the stiffening trusses of the Delaware River suspension bridge, E. R. Morehouse, Inc., of Camden, the contractor, equipped a Universal truck crane with flanged wheels to fit standard-gage track. Thus equipped, the machine traveled on completed track and transferred material through 180 deg. from a car behind to the steel bridge stringers in front. Swinging a 35-ft. boom at a low angle to clear overhanging sidewalk brackets above the track space, the truck crane handled loads weighing up to 3,900 lb. at 25- to 30-ft. radius. By laying the eastbound rapid-transit track ahead of itself, the truck crane progressed for 6,000 ft. across the south side of the bridge and then repeated the process on the north side, placing the westbound track of the rail transit line.

At a cost of $10,000,000 the Delaware River Joint Commission is completing a 2.68-mi. double-track rapid transit railway connecting two subway stations in downtown Camden with existing city-owned subways in Philadelphia. A general description of the line, with particular reference to construction of the subway sections, appeared in *Construction Methods,* Oct., 1935, pp. 26-30. E. R. Morehouse, Inc., was awarded a contract in October, 1934, at a bid price of $737,000, to lay track for the entire line, including the subway sections.

For operation on steel rails, the contractor replaced the six wheels of a Federal truck, on which the crane is mounted, with small flanged wheels set at 4-ft. 8½-in. gage. The four flanged wheels at the rear were mounted directly on the two drive axles, but the front axle was supported on a special four-wheel truck. A 25-ft. boom to which had been added a 10-ft. extension tip gave a total boom length of 35 ft.

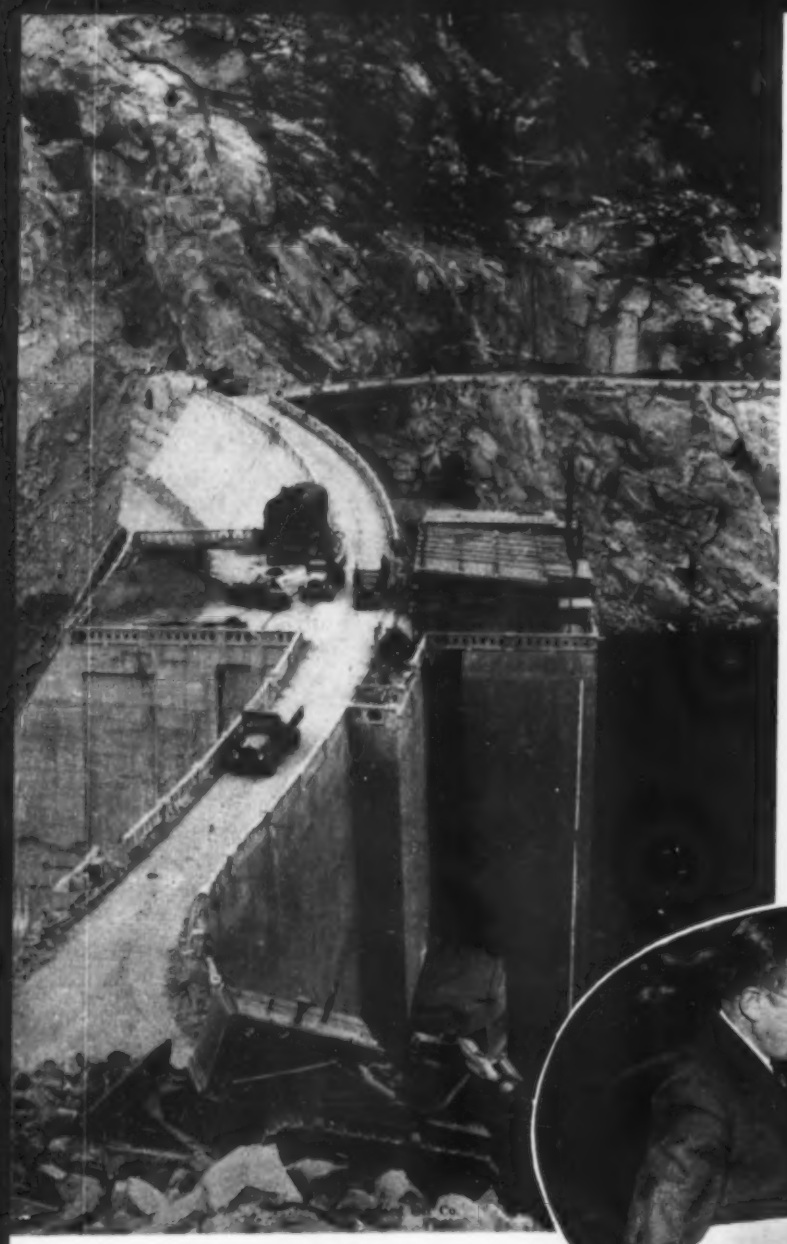
When laying track on the bridge, the crane moved forward close to the end of completed track and picked up crossties from a car behind, placing them ahead on stringers until sufficient ties had been laid to carry a 39-ft. rail. After the rail, weighing 1,500 lb., had been placed, the crane moved ahead to its next location. Nets were stretched in the space between the track stringer and stiffening truss to prevent men and material from falling through this opening.

Construction of the High-Speed Rail Transit Line between Philadelphia and Camden is being carried forward under the direction of Ralph Modjeski, chief engineer, and Modjeski, Masters & Case, consulting engineers, for the Delaware River Joint Commission of Pennsylvania and New Jersey. Montgomery B. Case represents both the chief engineer and the consultants at the site. Stephen Harris is engineer of design for the Joint Commission, and C. L. Appleton is construction engineer.

This Month's

Wide World Photo

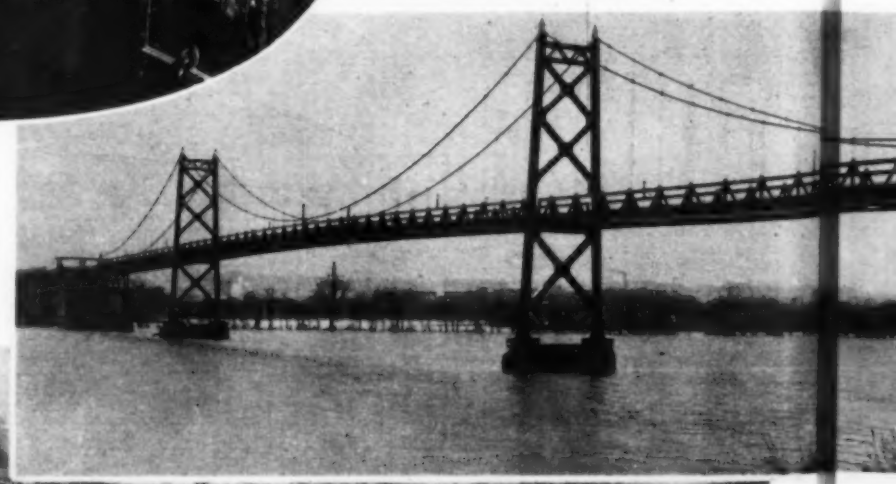
LARGEST PWA HOUSING PROJECT gets under way with ground-breaking exercises for Ten Eyck Houses in Williamsburg section of Brooklyn. Sub-standard buildings on twelve city blocks have been razed to permit foundation construction for new project, which will provide dwelling units for 1,625 families at cost of $12,783,000.



O'SHAUGHNESSY DAM, which stores water for San Francisco's Hetch Hetchy water supply project, is to be raised 85 ft. to increase reservoir storage capacity 70 per cent. Transbay Construction Co., contractor, will soon start placing 275,000 cu. yd. of concrete. Grading operations are in progress in foreground. Tunnel in rock abutment in background will serve vehicular traffic crossing dam on highway at new crest level.

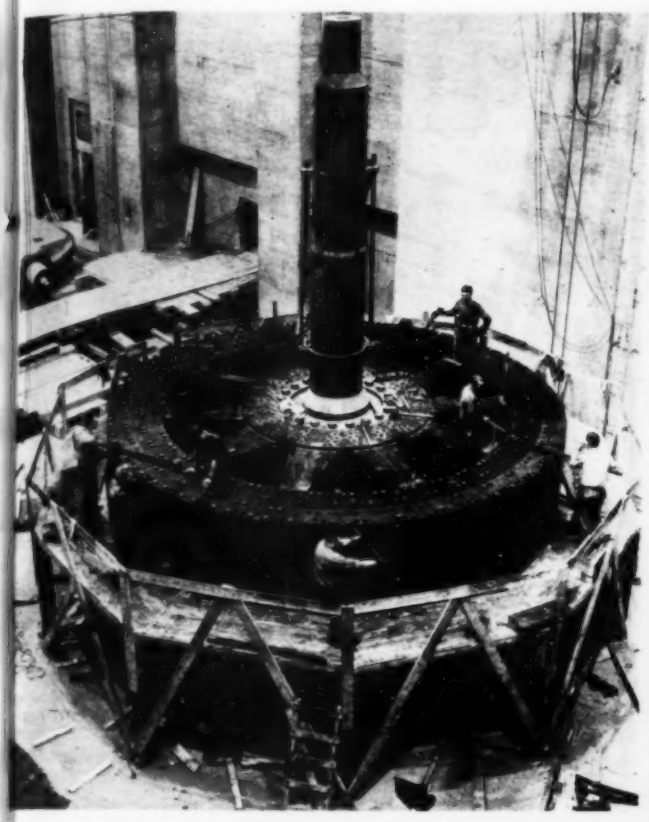
Harris & Ewing Photo

FINAL CONTRACTS *(left)* for 48 projects now under construction by PWA Housing Division, are mailed by A. R. Clas, director, and H. L. Small, construction chief.



HIGH WATER AT TYGART DAM, near Grafton, W. Va. Flow of 22,000 sec.-ft., as compared with normal flow of 500 sec.-ft., raises water level within 3 ft. of top of cofferdam. Contractor permits water to rise inside coffer to depth of about 10 ft. during flood, before pumping out and resuming concreting. *Photo from* RANDALL CREMER, *vice-president, Frederick Snare Corp., contractor.*

"NEWS REEL"



WORLD'S LARGEST GENERATORS are installed in Boulder Dam power house. Rotor of first of four 82,500-kva. units included in initial installation is placed in Nevada side of power house, where it will generate power for city of Los Angeles. Plant is designed eventually to contain fifteen 82,500-kva. units, each more than twice as large as any generators previously installed, in addition to two units of 40,000-kva. capacity. Power generation will begin this spring.

ERECTION OF DECK STEEL in pre-assembled units on suspension span of San Francisco-Oakland Bay bridge proceeds toward towers simultaneously from ends of side spans and both ways from center of main span. Stiffening truss panels and upper and lower floor beams are assembled in units weighing 50 to 210 tons and are raised intact from barges by means of hoisting carriage riding on 20-in. cables. Hoisting engines rest on pier fenders. American Bridge Co., contractor.

Wide World Photo

JESSE JONES *(right)*, chairman of RFC, which is financing construction of San Francisco-Oakland Bay bridge, shakes hands with two steel workers while inspecting project.

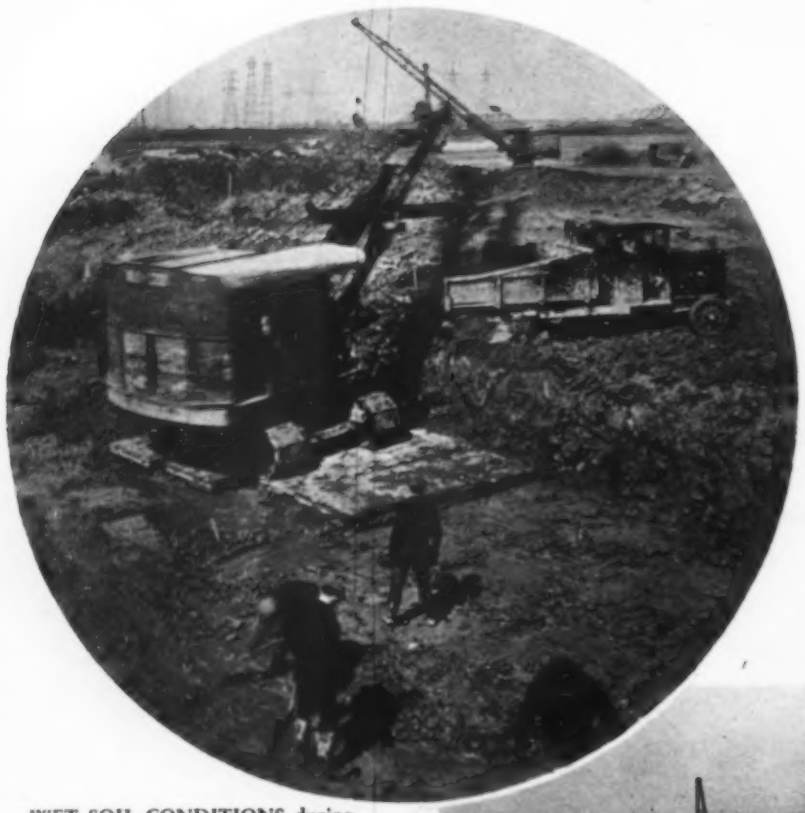
Wide World Photo

DAVENPORT PUBLIC TOLL BRIDGE *(left)* crossing Mississippi River 3 mi. above Davenport, Ia., has 740-ft. suspension span carrying 20-ft. roadway above Bettendorf, Ia., channel to narrow island in river. South of island, highway crosses Moline Pool to Illinois shore on two three-span continuous-truss units. Kansas City Bridge Co. built substructure, and McClintic-Marshall Corp. fabricated and erected superstructure of $1,500,000 project, financed by PWA.

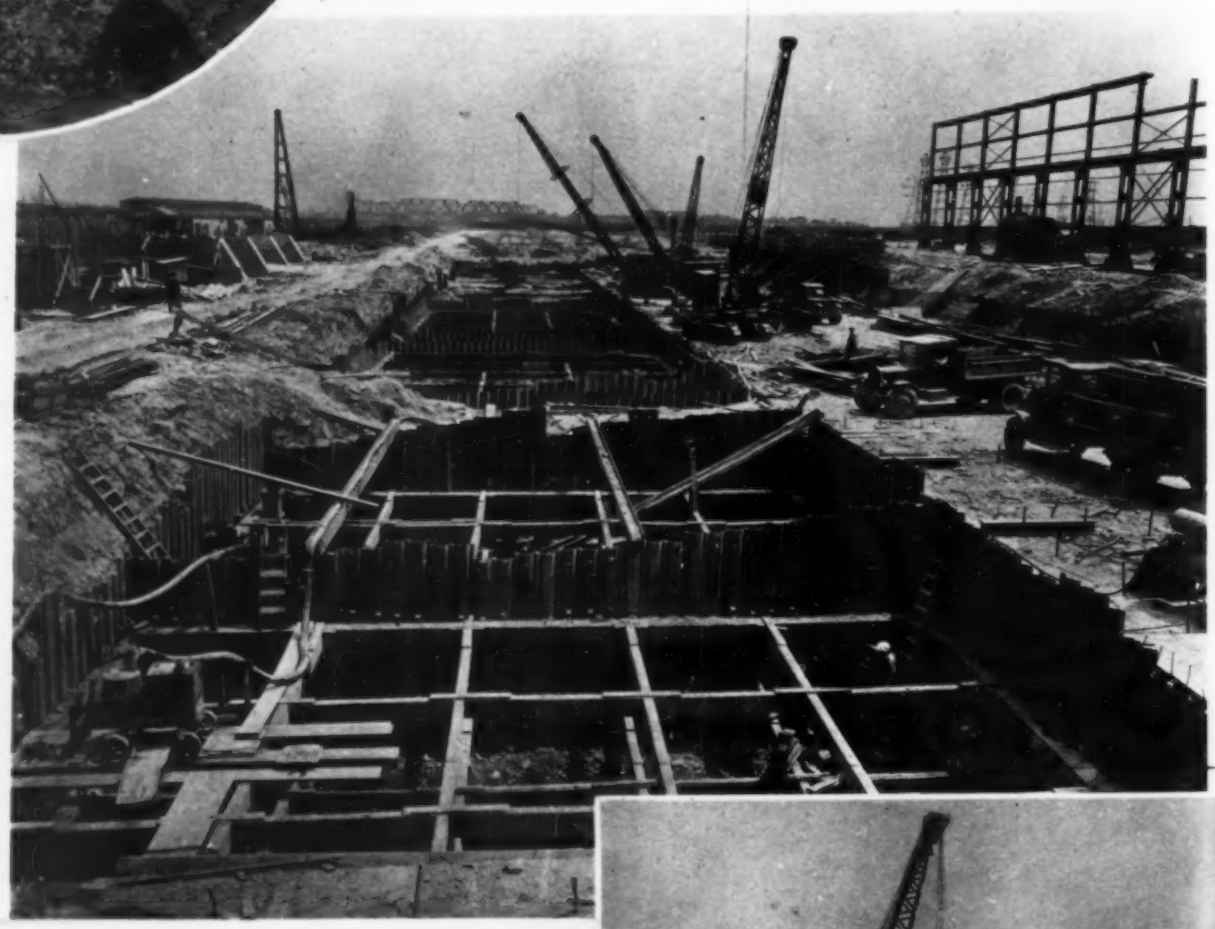
PICKICK LANDING PROJECT *(below)* on Tennessee River enters first stage of construction with excavation and concreting of lock foundations by TVA forces inside cellular steel sheetpile cofferdam. After lock has been constructed, steel sheetpiles will be re-used to inclose power-house area on opposite bank of river. Spillway connecting power-house and lock will be built in third and final stage of construction.

14,500 STEEL H-PILES

Support $20,000,000 Strip Mill



WET SOIL CONDITIONS during spring months require use of timber mats under power shovels. Tractor-trucks haul heavy loads in muddy ground.



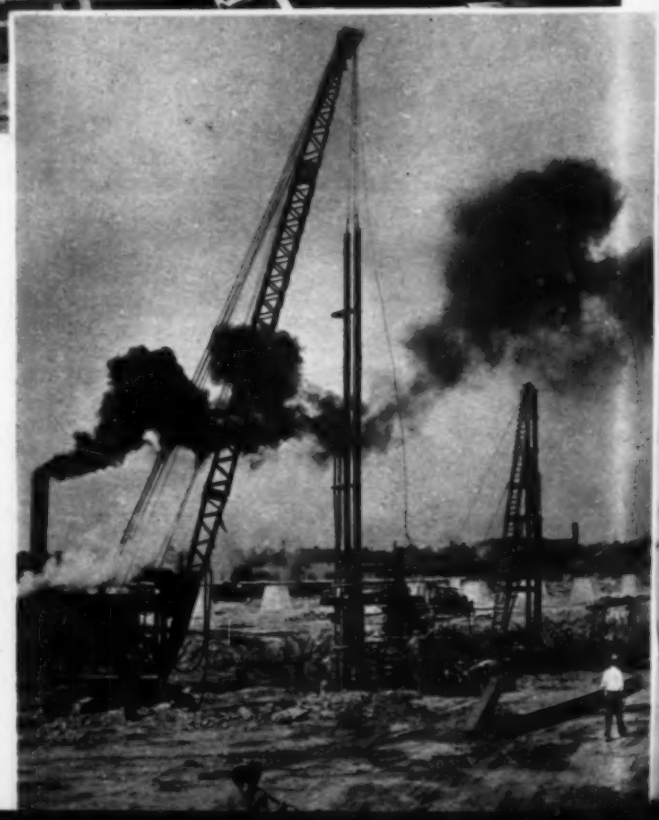
AS A PRACTICAL demonstration of the utility, efficiency and economy of H-section steel piles for foundations of heavy industrial buildings and mill machinery, the Bethlehem Steel Co., Bethlehem, Pa., drove to bedrock 14,475 10-in. 57-lb. steel H-piles 14 ft. to 48 ft. long to carry a new continuous plate, strip and sheet mill being added to the company's Lackawanna plant, about 2 mi. south of the Buffalo, N. Y., city line. In addition to the large number of steel H-piles, James Stewart & Co., Inc., foundation contractor, placed 70,500 cu. yd. of concrete in machine foundations, column piers and foundation mats. Nearly all these substructures rest on groups of steel H-piles. Operating four piledriving rigs and a fleet of eleven 4-yd. truck mixers, the foundation contractor completed the driving of about 1,000 piles and the placing of 4,000 to 4,500 cu. yd. of concrete in a normal week of five 8-hr. days.

Plate, Strip and Sheet Mill—Comprising two complete rolling-mill units, a hot mill and a cold mill, the new addition to the Lackawanna plant puts 20½ acres of former truck-garden and farm land under roof. The hot mill, designed for a normal capacity of 50,000 tons of product per month, will roll sheet and plate 24 to 72 in. wide and from 18-gage to ¾-in. thickness. From 15,000 to 20,000 tons per month of coiled hot-mill product will be further processed by the cold mill, which will be equipped to roll strip sheet 24 in. to 72 in. wide in various thicknesses ranging to a minimum of 26 gage, giving a surface finish to the thin sheets for use in automobiles, metal furniture and similar products.

Buildings of both the hot mill and the cold mill are of the standard steel-frame mill type, constructed of Bethlehem shapes, fabricated and erected by the McClintic-Marshall Corp., and roofed with Robertson protected metal to resist the action of corrosive fumes. Machinery for the two units is being supplied by the Mesta Machine Co. of Pittsburgh.

Steel H-Pile Foundations—Speed of construction and eventual economy of the steel H-pile foundations led the engineers of the Bethlehem Steel Co. to select wide-flange column piles to support the heavy loads of the new continuous plate, strip and sheet mill.

STEEL SHEETPILE CELLS, braced with timber framing, inclose roughing mill foundation, being excavated to rock.

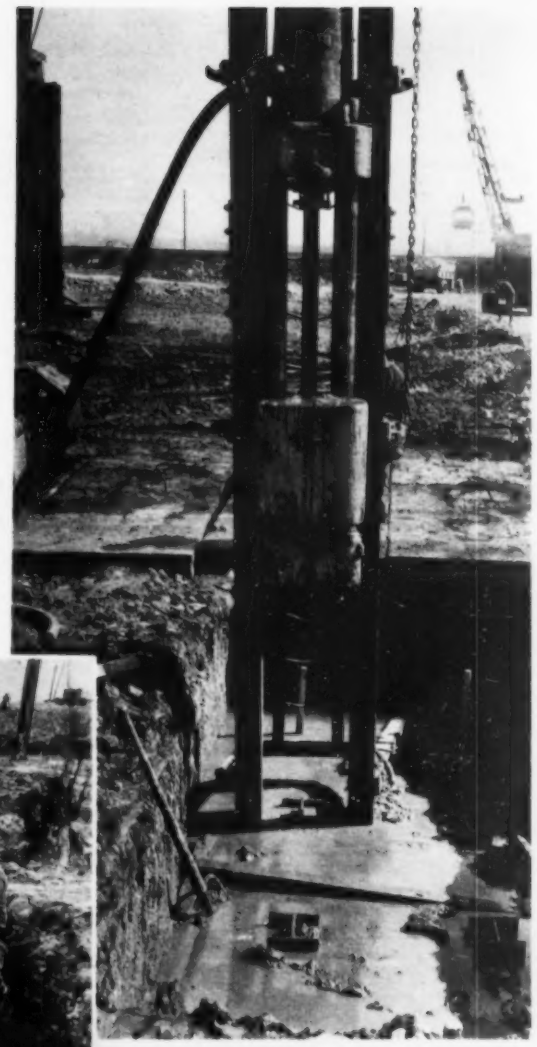


TWO TYPES OF DRIVERS *(right)*, utilizing double-acting hammer in swinging leads and single-acting hammer in fixed turntable leads (in background) put down steel H-beam piles for cold mill.

Preliminary soil tests comprising both excavated pits and borings were made at the site to determine the depth to sound bedrock and the character of the overburden. A satisfactory foundation for the piles was found in a stratum of Marcellus shale. The shale stratum slopes from south to north, requiring piles ranging in length from 14 ft. at the south end to 48 ft. at the north end of the site.

On top of the shale lie successive layers of sand and gravel, soft blue clay and yellow clay, through which the H-piles were driven to bearing on the shale. As a criterion of the life to be expected from steel piles, it can be said that examination of steel H-section piles (unprotected by concrete) extracted from Nebraska bridge foundations after 20 years and of solid section circular steel piles exposed to salt water in the Gulf of Mexico for 31 years indicates that the loss of section in the steel H-piles under the new mill will have no bearing on the life of the plant.

Load-Bearing Tests—As a check on the conservative loadings adopted in designing the pile foundations of the mill, a load test was made on a typical pile at the site to determine the bearing value of the foundation rock and of the pile itself. Supplementary tests to obtain information (not directly applicable on this project) regarding the load-bearing value of friction piles were made by driving a 10-in. 57-lb. steel H-pile to various penetrations in the gravel stratum overlying shale bed-



FIRST H-PILES are driven March 27, 1935, by single-acting steam hammer in column foundation of hot-mill building.

STEEL BRACING FRAMES *(below)*, suspended by hanger rods from top of sheetpiling shore steel sheetpile walls around settling basin for hot mill.

DRAGLINE *(left)* starts excavation to bedrock inside lines of steel sheetpiling at one end of mill foundation in hot-mill building.

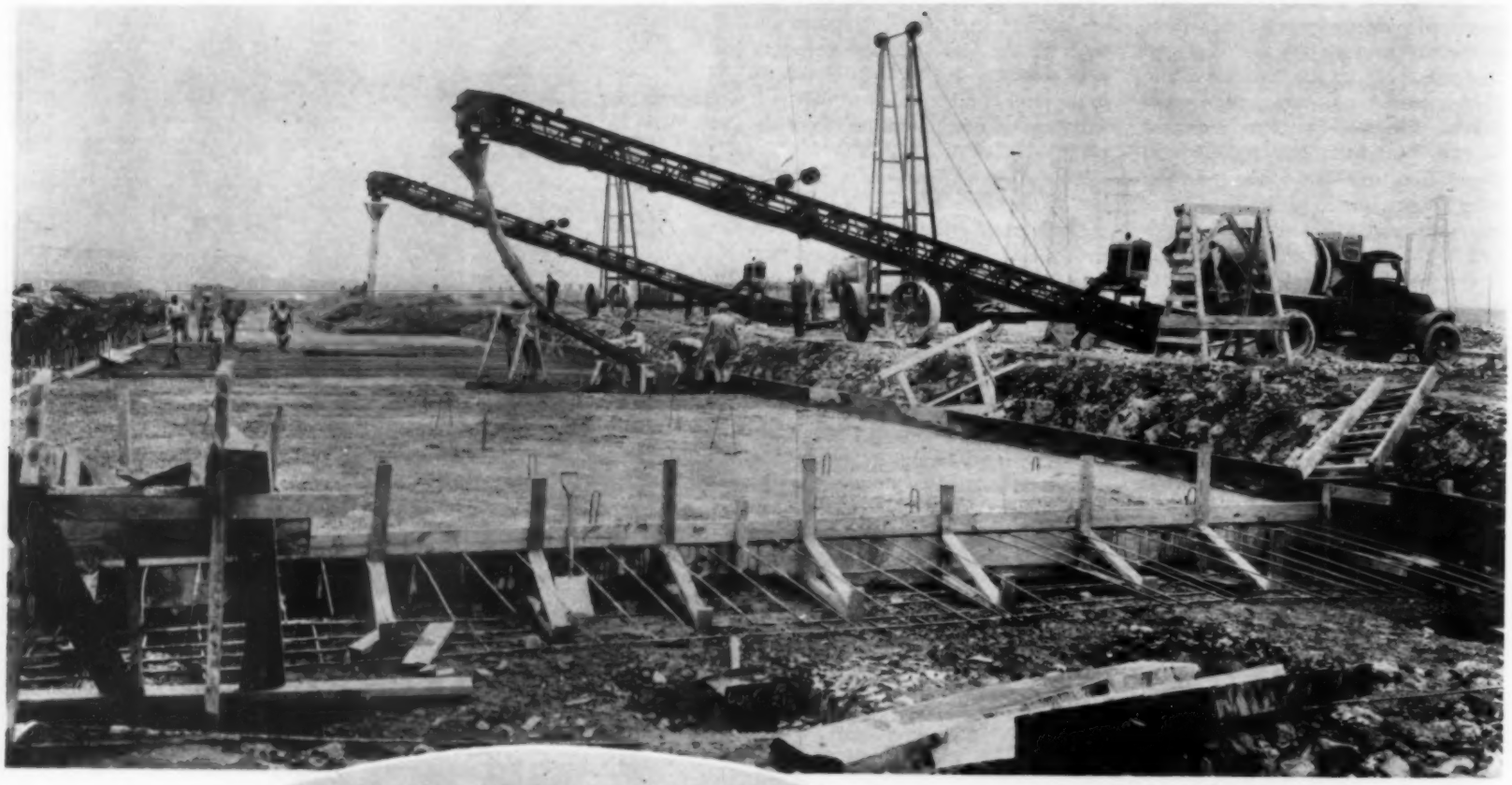
rock and loading the pile to ultimate capacity at each level.

In making the friction tests, the engineers employed H-section anchor piles and jacks to load the pile under test. Before using anchor piles for this purpose, the testing engineers drove a pile to rock in a typical location and pulled the pile to determine its reaction value.

Accompanying photographs illustrate the methods utilized in making two of the tests, and the captions give the essential data obtained. The results, of course, are conclusive only for the site at which the piles were driven, but they indicate the performance to be expected from H-section piles installed elsewhere under corresponding conditions.

Piledriving—Before ordering steel H-piles, the contractor made supplementary tests to determine the depth to bedrock by driving steel rods at closely spaced locations in progressive lengths from the surface of the ground to refusal. To extract driven rods, the contractor utilized an ingenious steel "pump-handle" jacking device which gripped the rod and raised it about 18 in. at a time when one or two men bore down on a long steel lever. After each rise the device was quickly lowered on the rod to repeat the pumping motion.

One steam turntable rig and three cranes carrying swinging leads averaged 45 to 50 piles per machine in an 8-hr. shift. Working three drivers for



FOR LONG-RANGE DISTRIBUTION, where chutes cannot serve, contractor uses two 50-ft. belt conveyors with delivery ends elevated to permit elephant-trunk spouts to be swung over wide area.

4,500 cu. yd. in 40 working hours, the contractor erected a complete Butler batching plant which in actual operation exceeded its conservatively estimated capacity of 100 cu. yd. an hour. The plant was set up alongside a ship canal to permit barge delivery of sand and gravel. Eleven transit mixers of 4-yd. rated capacity mounted on Mack trucks hauled 4-yd. batches 2¼ mi. from this plant to the job, mixing the concrete by power takeoff from the truck transmissions while traveling at speeds up to 30 mi. an hour. Trucks were loaded at the plant in as short a

BOTTOM-DUMP BUCKET places concrete in pier form for column of mill building.

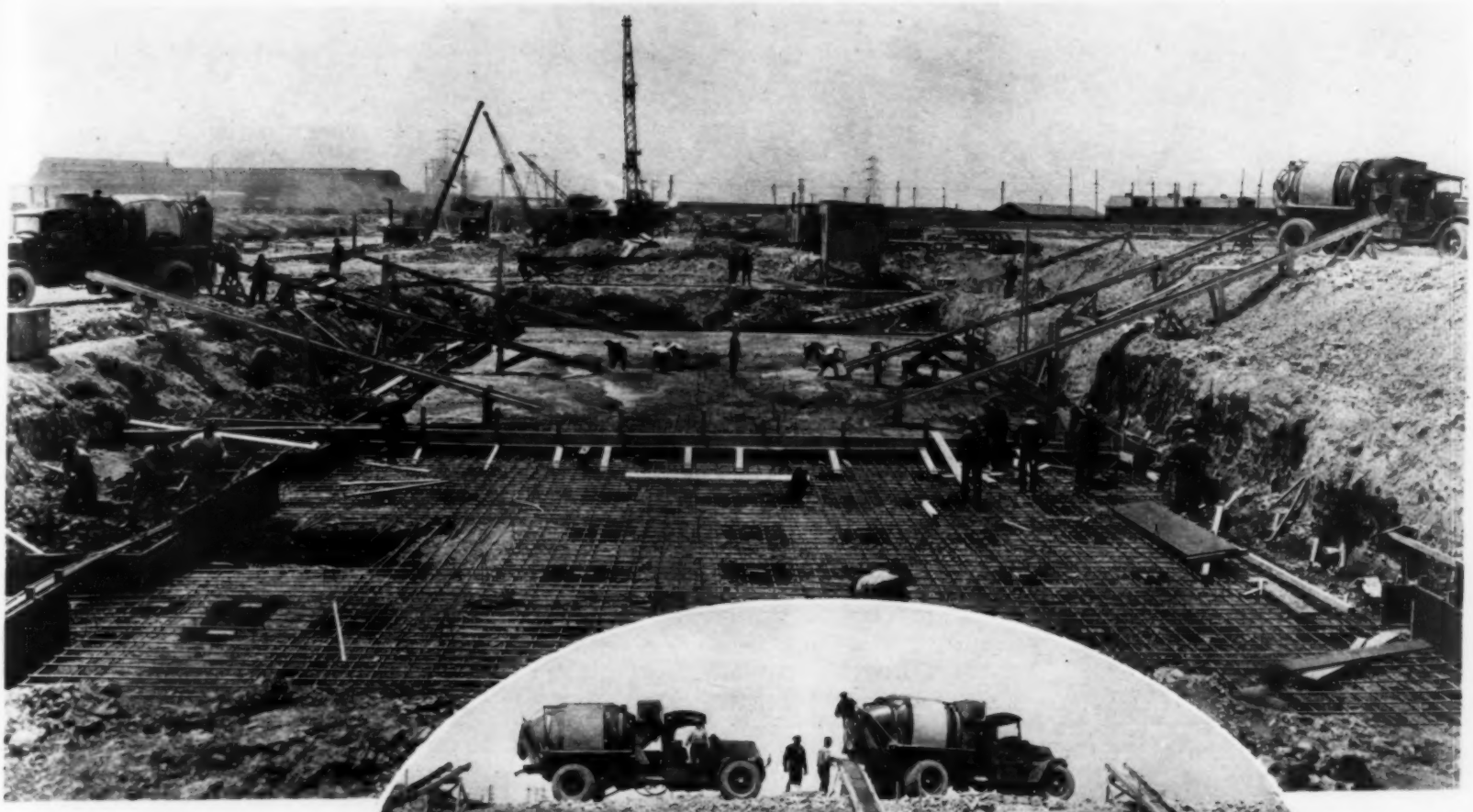
a single shift and the fourth machine for a double shift of 16 hr., the contractor in one day drove 350 H-section piles. Average length of piles for the entire project was about 25 ft. after cutoff.

After cutoff grade had been marked on a driven pile by the engineers, the excess length was burned off with an oxyacetylene torch, a special clamp on the pile being used to guide the tip of the torch. Cap plates for the piles were sheared pieces about 12 in. long of 15-in. 49-lb. I-beams punched at the center of the web with a 3-in. hole to permit welding at two points on the circular opening to the web of the steel H-pile. Flanges of the I-section cap were placed parallel with the web of the H-section pile. The tack welds were made electrically.

Concrete Foundations—To meet a weekly concreting schedule of 4,000 to

FOR SUPERSTRUCTURE CONCRETE above level of truck mixers, cranes handle material into forms with controllable-dump buckets.

TWO CRANES *(right)* handle bottom-dump concrete buckets placing 1½-yd. loads in forms for hot-mill foundation. Steel frame over one aisle has been erected in background.

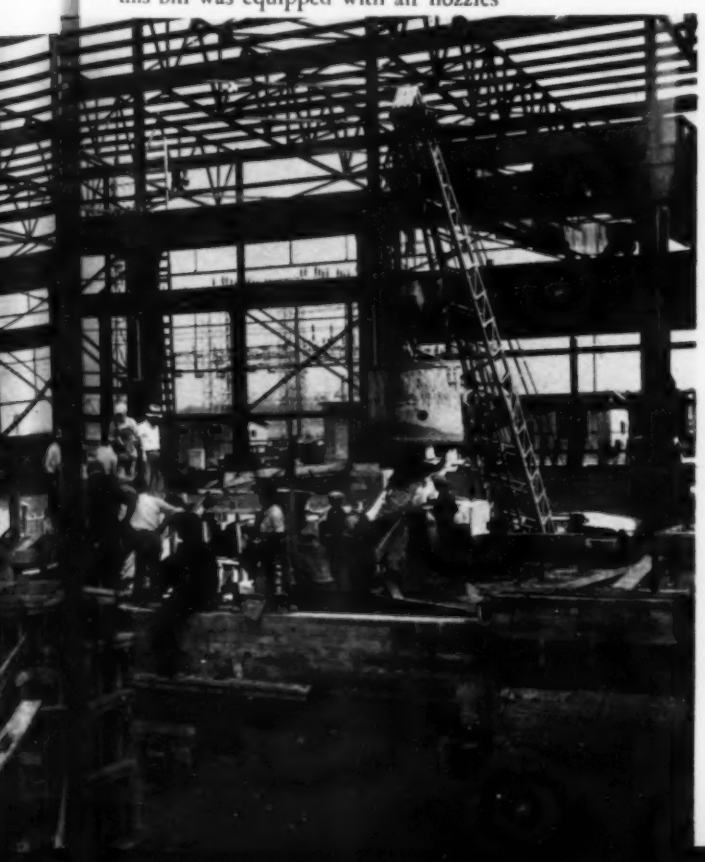


FROM TWO SIDES truck mixers chute concrete to reinforced mat of motor - generator building. Note capped H-section steel piles supporting reinforcing bars.

period as 1 min. 2 sec., including the time required to remove and replace the cover. When charging mixers in succession, the trucks drove away from the plant at average intervals of 1 min., 30 sec., indicating an actual plant capacity of 180 cu. yd. an hour.

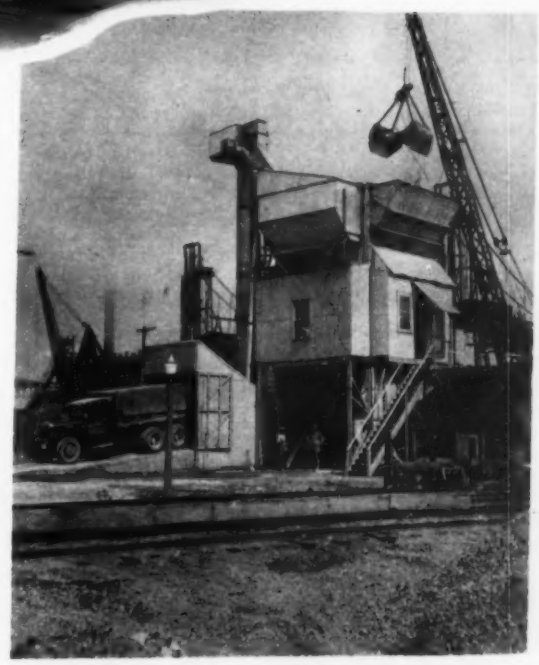
Bargeloads of sand and gravel were unloaded by a crawler crane with a clamshell bucket, which either charged the 80-yd. overhead bins of the plant directly or transferred the material temporarily to stockpiles. Bulk cement was delivered to the plant by covered trucks which dumped the material into the boot of a bucket elevator feeding an 800-bag overhead bin. The boot of this bin was equipped with air nozzles for agitating the cement. Dry materials were weighed by beam scales in large-capacity hoppers which discharged into the trucks. Water was measured in an automatic gaging tank and was discharged into the mixer drums simultaneously with the dry materials. All gates and valves were manually operated by one man.

TRUCK MIXERS deliver 4-yd. batches of concrete through chutes to foundation mats.



Gravel concrete was used for foundations below water level, for thin walls, and for all structures where waterproof concrete was required. Slag aggregate was selected for other uses. For floors, thin walls and watertight concrete, the designed mix was based on volume proportions of 1:2:4. In building piers and heavy mass foundations, the concrete mixture with gravel aggregate was based on volumetric proportions of 1:2½:5.

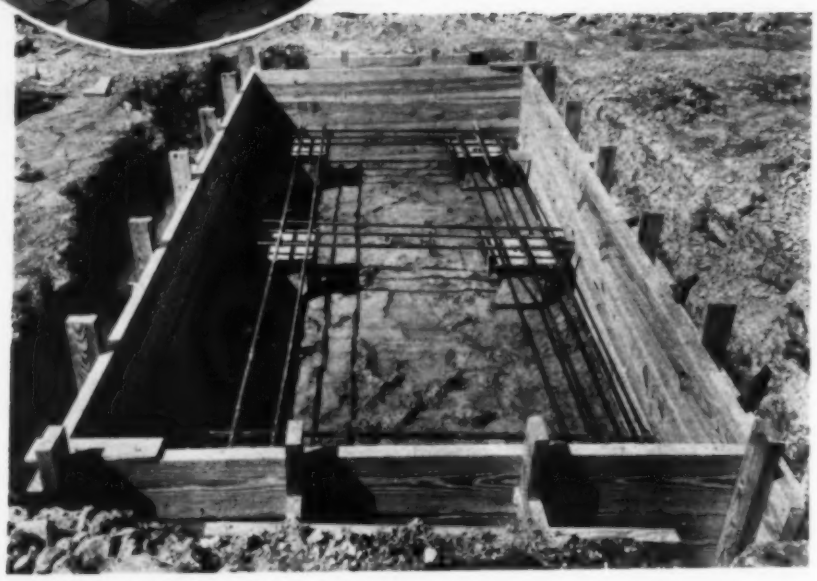
Wherever possible at the site, the truck mixers chuted the concrete di-



FAST-CHARGING BATCHING PLANT loads 4-yd. batches into truck mixers at rate of one full batch every 1½ min. Bulk cement is delivered by covered end-dump trucks which discharge into boot of bucket elevator. Crane-operated clamshell handles sand and gravel from stockpiles or barges to 80-yd. overhead bins.

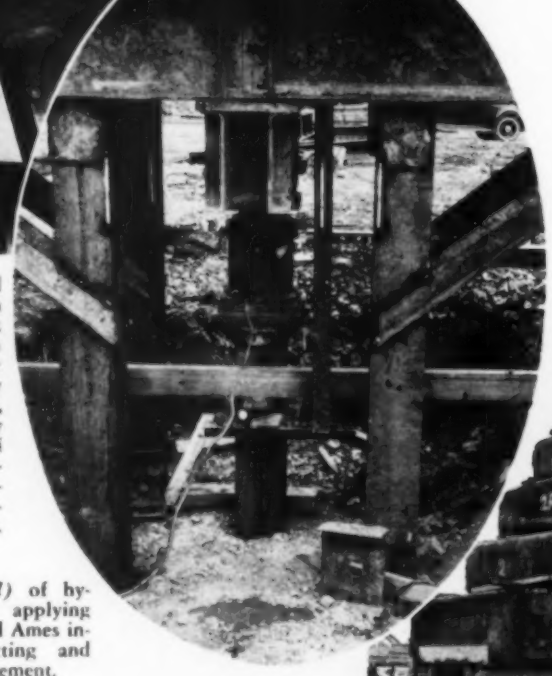
SPECIAL CLAMP guides tip of gas torch in cutting off tops of H-beam piles.

PUNCHED I-BEAM CAP *(left)*, is welded by electric arc to web of H-beam pile at two points of contact between pile web and circumference of circular opening in cap.



TYPICAL COLUMN FOOTING ready for concrete, with forms in place and reinforcing bars resting on welded I-beam caps of H-section steel piles.

TO MEASURE REACTION VALUE of anchor piles to be used in other tests, 10-in. 57-lb. H-pile, 34½ ft. long, is driven through yellow clay, soft blue clay, and sand and gravel to shale bedrock at penetration of 30.42 ft. Pile is pin-connected to lever arm which rests on rolled bearing at one end and on hydraulic jack at other end. Ames indicator is used to detect initial movement of pile. By means of hydraulic jack, testing engineers apply total lifting force of 64 tons to overcome frictional resistance of pile, indicating conservative ultimate capacity of 45 tons.



DETAIL *(in oval)* of hydraulic jack for applying pressure to pile and Ames indicator for detecting and measuring movement.

LOAD BEARING TEST *(right)* on 10-in. 57-lb. H-section pile 27.91 ft. long driven through yellow clay, a thin layer of sand, soft blue clay, and sand and gravel to shale bedrock 23.92 ft. below surface of ground. Hydraulic jack applies load to pile and Ames indicator measures movement of pile. Purpose of test is to determine load-carrying capacity of rock under pile and to study effects on pile itself. Movement of pile ceased and pile became stationary after each successive application of loads up to 139.9 tons, when movement of pile became continuous. Settlement at 127 tons was about 0.23 in., as compared with theoretical elastic deformation at this loading of about 0.175 in., indicating that pile had penetrated about 0.055 in. into bedrock. Pile recovered elastic deformation as load was released.

rectly into the foundation forms. For large foundation mats which could not be concreted directly by the mixers, the contractor used two portable gasoline-powered 50-ft. belt conveyors. Concrete for structures above ground level was placed by cranes which handled 1½-yd. loads in bottom-dump concrete buckets. These buckets were equipped with two semi-circular gates, operated by individual levers, which controlled the flow of concrete into the forms.

Progress—A contract for the foundations was awarded to James Stewart & Co., Inc., on Feb. 26, 1935. Poor drainage of the flat farm land on which the plant is being built slowed down excavating operations during the early spring months, until an adequate drainage system had been installed.

First foundation piles were driven at the site of the hot mill on March 27, 1935. It was expected that the hot mill would be ready to start operating early in 1936.

Direction—Foundation design and construction for the new continuous plate, strip and sheet mill were under the supervision of W. A. James, chief engineer of the Lackawanna Plant, Lackawanna, N. Y. Andrew Fischer, Jr., was superintendent in charge of foundation construction at the site for James Stewart & Co., Inc.

13-Story Building
CUT IN TWO
And Set Back 5Ft.
To Widen Street

CONSTRUCTION SURGERY of a unique and daring type was performed successfully in an operation to prevent the 13-story Commercial Exchange building in Los Angeles, Calif., from encroaching beyond a newly located building line set back 5 ft. from its original location by municipal ordinance as part of the project of widening Olive St., along which one side of the tall reinforced-concrete structure fronts. Instead of slicing off the necessary amount from the entire facade of the building, a procedure which, in addition to marring the architectural appearance of the structure, would have reduced the size and lowered the rental values of outside office space and, particularly, store areas at street level, it was decided to adopt an alternative plan suggested by George R. Kress, president of the Kress House Moving Co., of Los Angeles.

In its essential features this plan consisted of cutting a gap in the building, for its full height and width, at a point about 50 ft. back from the Olive St. front, and then moving the disconnected front unit of the structure 5 ft. to the rear to close up the opening. This scheme left intact the Olive St. facade, with its corner offices and ground floor store, and shortened the structure along West 8th St. by reducing the size of only two offices and corridors per floor at a point where an interior light court is located. The operation was performed without making it necessary for the tenants of the building to vacate the structure even while the front portion was being moved back.

The width of the cut made through the exterior walls and main body of the structure, as illustrated in the accompanying photographs, is 8 ft. 6 in., a distance 3½ ft. greater than the required 5-ft. setback. The excess space was required for cutting off and overlapping the steel reinforcement in the concrete beams and floor slabs of the structure, the overlap sections of steel being joined securely by welding. To obliterate the scar along the line of the closed gap between the two sections of the building a tier of windows somewhat wider than those in the original structure was installed.

The section of building to be moved after the structure had been cut in two was approximately 50x55 ft. in plan and 160 ft. high. Its weight was estimated at 5,000 tons. This section was first underpinned at the column footings, involving excavation to a depth of 10 ft. below the basement level. At the same time heavy reinforced-concrete mat sub-footings were poured to carry the column loads of the structure in its new set-back location. By a system of jacks the load of the 13-story section of the building was then transferred to steel rollers and tracks on which it was moved back the necessary 5 ft.

In addition to adequate support for the structure the moving operation involved the installation of special bracing and pulling equipment, at every second floor and a battery of thirty screw jacks in the basement to push the severed building unit along the path of its 5-ft. travel. After the initial shove it was found that the number of these screw jacks could be reduced to twenty. The jacks were each 2½ ft. long and had a lifting capacity of 40 tons. A system of electric lights covering all points at which jacks or pulling devices had been installed guided the operators of the devices in applying power uniformly in moving the structure. A period of 9 hr. elapsed between the first shove and the time the structure was in place over its new concrete mat footings. For the actual moving operation a crew of 75 men were on the job.

For the Kress House Moving Co., of Los Angeles, all operations involved in cutting, setting back and closing the gap in the Commercial Exchange building were planned and supervised by its president, George R. Kress.

SETBACK OF 5 FT. has been completed and 3½-ft. opening remaining in original 8½-ft. gap in side of structure is ready for installation of tier of windows.

COMMERCIAL EXCHANGE BUILDING LOS ANGELES, CALIF.
HIGHEST BUILDING EVER MOVED IN THE WORLD
MADE POSSIBLE BY GEORGE R. KRESS PATENTED METHODS
1935 KRESS HOUSE MOVING CO. CONTRACTORS

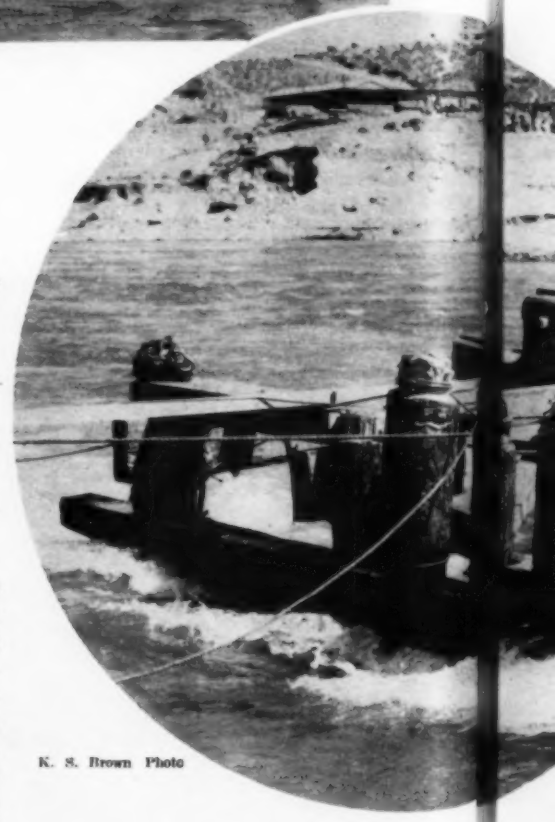
CUT 8½ Ft. WIDE, throughout entire height and width of building, is made preparatory to moving front portion 5 ft. back from street.

SPECIAL PILE DRIVING RIG on barge drives timber piles for trestle in swift current 60 ft. in maximum depth.

K. S. Brown Photo

Contractors Build Trestle in

FIGHT AGAINST RAGING RIVER



K. S. Brown Photo

SWIFT CURRENT of Columbia River made it difficult to spot the piles for driving and to hold them in place.

Dunco & McPherson Photo

WIRE CABLES (*left*), anchored to shore, guy pile clusters against thrust of swiftly flowing river. Note 12x12-in. headers bolted across between pairs of pile clusters.

HIGH-WATER season on the Columbia River is the summer time when melted snow from the mountains as far north as the Canadian Rockies start turbulent floods toward the ocean. Contractors on the Grand Coulee dam have to carry on during high and low river stages and they study the river as men must where profit and, indeed, even the lives of workmen, depend upon accurate estimates and shrewd foresight.

During the high-water season just past excavation was under way on the east side of the river. The spoil from this work could have been disposed of more conveniently over the long belt conveyor system on the west bank, but in between the two banks rolled the Columbia in flood. The advantage of getting the spoil across the river was great and there was feverish haste to build a trestle on which a belt conveyor could operate. Thus, when the flood flow had begun to subside and long before "low-water" stage was reached, endeavor was made to build a trestle in waters still so swift, deep and treacherous as to make this job one of the most difficult thus far undertaken in connection with the Grand Coulee project. How unusual difficulties were met and overcome in fighting this battle with the Columbia are outlined below.

During the preceding low-water season careful soundings had been made

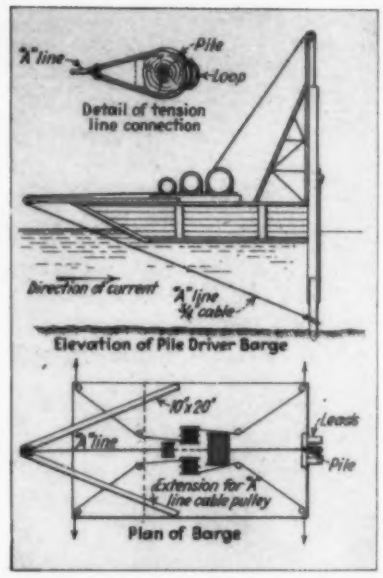
across the channel at the point where the trestle was to be built. Using that profile as representative of bottom conditions, it was estimated when work on the trestle was planned that the water depth would be 50 ft. However, when the work was started it was discovered that high water had scoured the bottom, doubtless because of the channel constriction resulting from the west cofferdam, and that the actual depth was 60 ft. At this time the channel was about 600 ft. wide at the trestle site and the stream velocity was about 15 m.p.h.

A 37x59-ft. barge equipped with piledriver leads was put in position for driving the first piles and was anchored there by five steel cables. The rake of the barge was headed upstream and from this end a cable was fastened to a bicycle trolley running on a cable across the river above the trestle site. The cable across the river was firmly fastened to deadmen buried in either bank and the trolley automatically moved along the cableway as the position of the barge was changed by the four anchor cables to shore. One cable was passed from each corner of the barge to a fastening on shore. With two port lines and two starboard lines it was possible to spot and hold the barge accurately in position despite the current. The current was so strong that no head line was found necessary nor was one used throughout the job.

The leads of the piledriver were 26 in. apart and this was taken as the limit for this size of piles that were used. Special piling was ordered from the coast for this work, green Oregon pine was selected and sticks 90 ft. long tapering from 26 in. at the top to not less than 10 in. at the butt were used. It was found desirable to strengthen these piles in that portion of the length that would be exposed to the current after driving. To accomplish this a pair of 8x12-in. timbers, one on the upstream and one on the downstream side, were bolted to the pile before driving. The bolts went entirely through pile and both timbers.

At one time the error was made of attempting further to reinforce the exposed portion of the pile with 3x12-in. timbers spiked to the sides of the piles; that is, on the two sides at right angles to the 8x12 timbers just mentioned. Heavier timbers could not be used on the sides because the space between the leads did not permit. The 3x12's were found to be not strong enough to resist the current; the current split them off and allowed them to shoot upward out of the water with great violence. By almost instinctive reaction acquired on the football field, the superintendent on this job, G. C. ("Pete") Willson, succeeded in dodging one of these pieces which suddenly lunged out of the turbulent flood aimed at his chin. His alertness avoided a fatality but a painful injury resulted nevertheless. After the split plank nearly got Pete this plan for strenghtening the piles was abandoned. There were several other narrow escapes but the job was completed without a fatality.

Before the wood piles were used experiment was made with steel I-beams. The beams used were 80 ft. long, 8x21 in. in section, and weighed 73 lb. per foot. However, when they were lowered into position and before they could be spotted on the bottom, they were so badly bent out of shape by the force of the current that driving was out of the question. The wood piles offered less resistance to the water but they were not stiff enough to withstand the strong current unless stayed in position with cables. That is, when driving had been completed and the pile was released from the leads, it was, in effect, a vertical column against which current pressure was exerted for a depth of 60 ft. This pressure invariably would snap off the pile unless it had some form of support near the top.



PILE-DRIVING BARGE, showing application of A-line in staying piles. Lines to shore from four corners supplemented main anchor line which extended directly upstream to bicycle trolley.

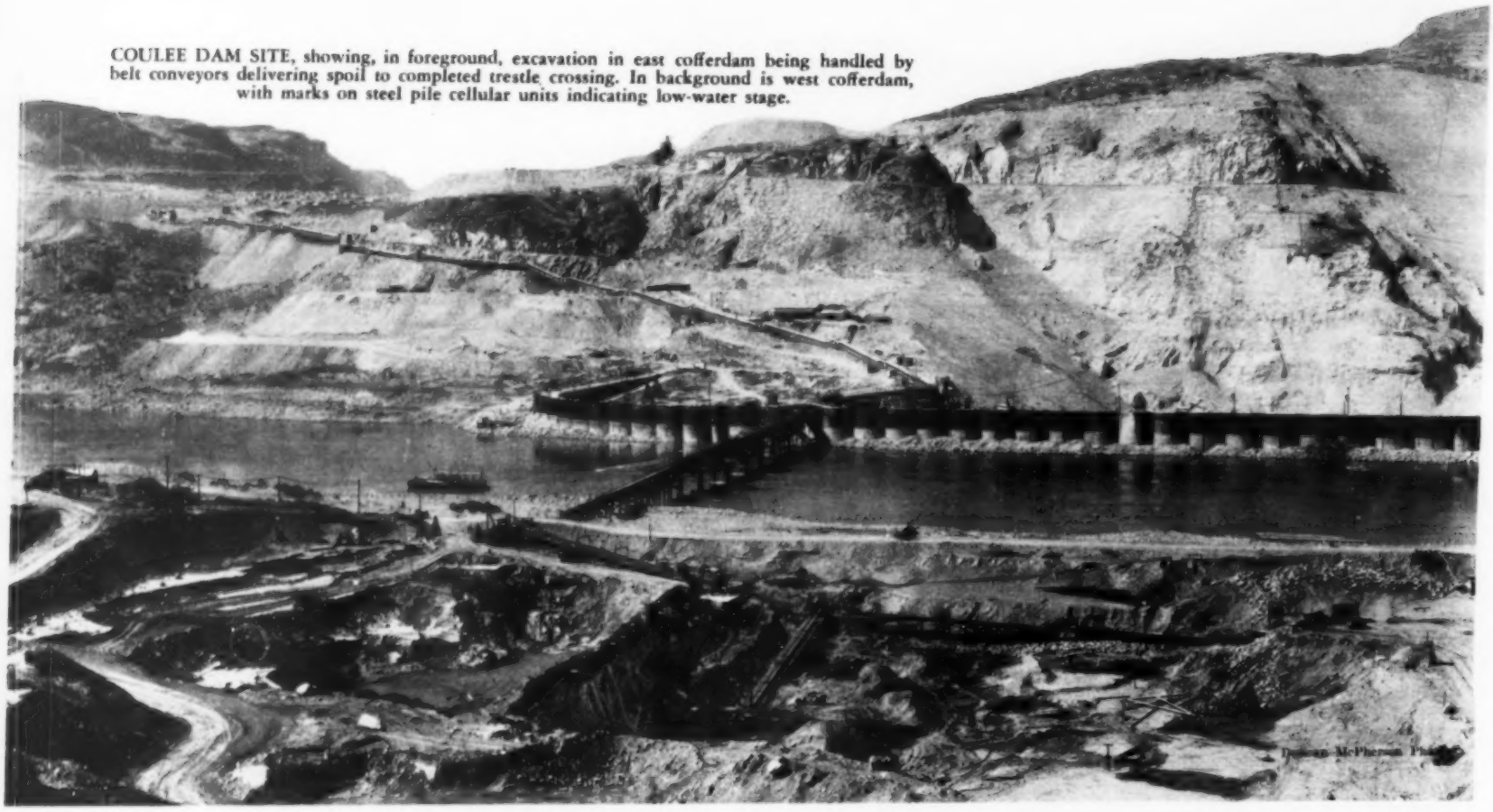
Each pile, therefore, was anchored to both shores and to a cross cable before it was released from the driving leads. Even so a pile was in a precarious condition until several others had been driven close by and the group had been fastened together at the top for mutual support. As each additional pile was added to a cluster, three turns of $\frac{5}{8}$-in. cable were put around the top to bind the new pile to the one or more already driven. This practice was continued until each cluster contained enough piles to insure stability. Sometimes as many as nine piles were driven for each cluster. Occasionally a cluster of as many as three piles firmly fastened together with cables at the top, would be snapped off by the current. Altogether about as many piles were broken by the current as were incorporated in the structure finally completed.

Strangely enough the actual driving of the piles was the least difficult part of the job. There were two critical operations in placing each pile; first, getting it down to the bottom without having the lower end snapped off by the current and second, getting the top of the first pile in each cluster sufficiently well anchored (usually by steel cables to anchorages on opposite sides of the river 400 or 500 ft. upstream) until enough other piles could be driven close by to give the cluster enough strength to resist the current. When the first pile in a new cluster was driven it was anchored to both shores and directly upstream to a cross cable. As quickly as more piles could be put down the cluster was fastened together by a wrapping of cable around the

THE BATTLE WON. In spite of construction difficulties, timber trestle is completed and ready for installation of belt conveyor to carry spoil across river.

K. S. Brown Photo

COULEE DAM SITE, showing, in foreground, excavation in east cofferdam being handled by belt conveyors delivering spoil to completed trestle crossing. In background is west cofferdam, with marks on steel pile cellular units indicating low-water stage.



piles above water line. As soon as each dolphin or pile cluster was finished a chain was put around it; the length of the chain band was carefully made just enough so that it would bind the cluster tightly together before the chain had worked down to the point where it would rest on the stays anchoring the pile to the dead-men on shore. Each dolphin had a taper resultant from drawing the pile heads together and this developed a binding effect in the chain as vibration, resulting from current pressure, worked the chain ring downward.

The driving operations were carried on on the upstream side of a 1¼-in. cable stretched across the stream along the lower edge of the proposed trestle. In order to clear the numerous guy cables the driving barge was kept upstream and the downstream row of dolphins was put in first. Later, as each additional cluster was added to the upstream row, a 12x12-in. header was bolted across between the two clusters of each bent to serve as a cap. The objective was to get these caps 77½ ft. apart thus constituting a spacing of this distance between bents to support the 80-ft. steel girders that were used as floor beams to carry a line of Jeffrey belt conveyors across the trestle.

The barge used in this driving process was equipped with two three-drum hoists and two gypsy heads. Three drums were used on the anchor lines, one each on the forward port and star board lines and the third on the port stern line. The starboard stern line was operated by one of the gypsies.

An absolute essential to the success of getting the wooden piles spotted was the tension line (marked A in the accompanying sketch) rigged from a sheave at the outer end of two 10x20-in. timbers extending over the upstream end of the barge. This line, a ¾-in. cable, passed from a hoist drum around the sheave and thence to a 12-ft. choker which was passed around the lower end of a pile after it had been placed in the leads and lowered a short distance into the stream. Tension in the A-line was intended to cause the choker to bite into the pile sufficiently to prevent slipping along the pile while it was being thrust downward through the swift current. However, after the pile had been spotted and driving was under way it was desirable to release the tension on the A-line and raise the choker to the surface so it could be removed. For this purpose a ⅞-in. cable loop large enough for a shackle was spliced into the choker line, as shown in the sketch, just at the center of the choker where it would bind into the pile. To remove the choker after the A-line had been slacked off, a line permanently fastened to the choker loop readily raised choker and A-line to the surface where it was removed from the pile.

The three drums of the second hoist on the barge were used as follows: One drum for the A-line, a second for the line extending from the barge directly upstream to the bicycle trolley and the third for the steam hammer line. The hammer was the largest available, a No. 10 McKiernan-Terry.

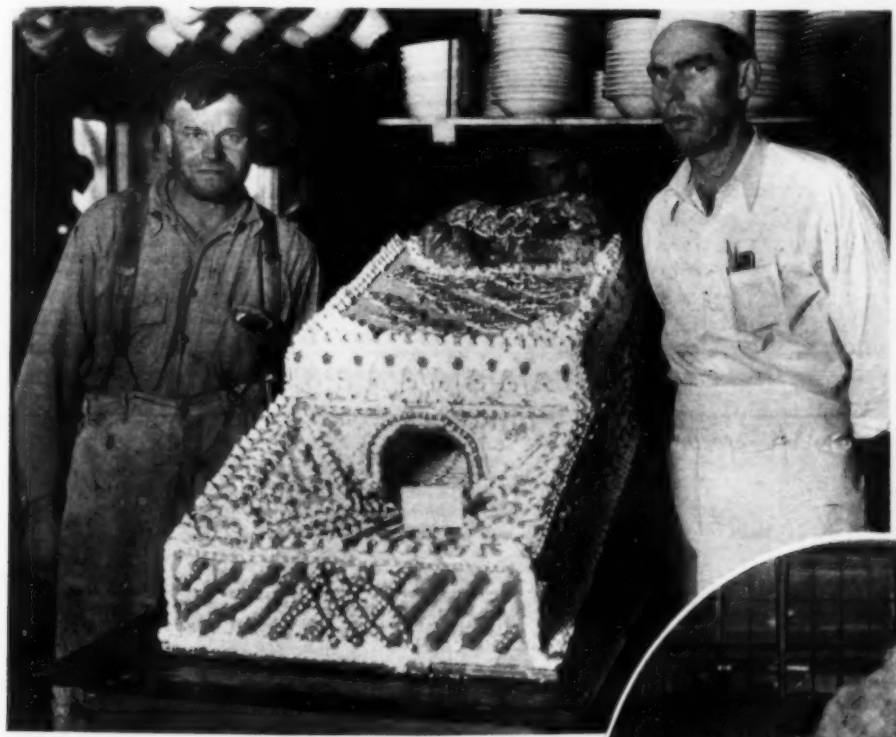
The driving could be carried on effectively only during daylight hours and for three weeks during the pile-driving period two shifts were operated, the first beginning with the early daylight hours and the second finishing as darkness set in.

The work was done by the general contractors on Grand Coulee project, the M.W.A.K. Co.; H. L. Myer, general manager and M. H. Slocum, general superintendent. Personal responsibility for details of the fight with the river in getting this trestle across rested upon G. C. Willson, superintendent of stream control,—who was on the firing line daily while the trestle was being built.

BELT CONVEYOR has been installed on completed trestle to carry spoil from east cofferdam across Columbia River to dump. View taken from west cofferdam, looking east.

JOB ODDITIES

A Monthly Page of
Unusual Features of Construction

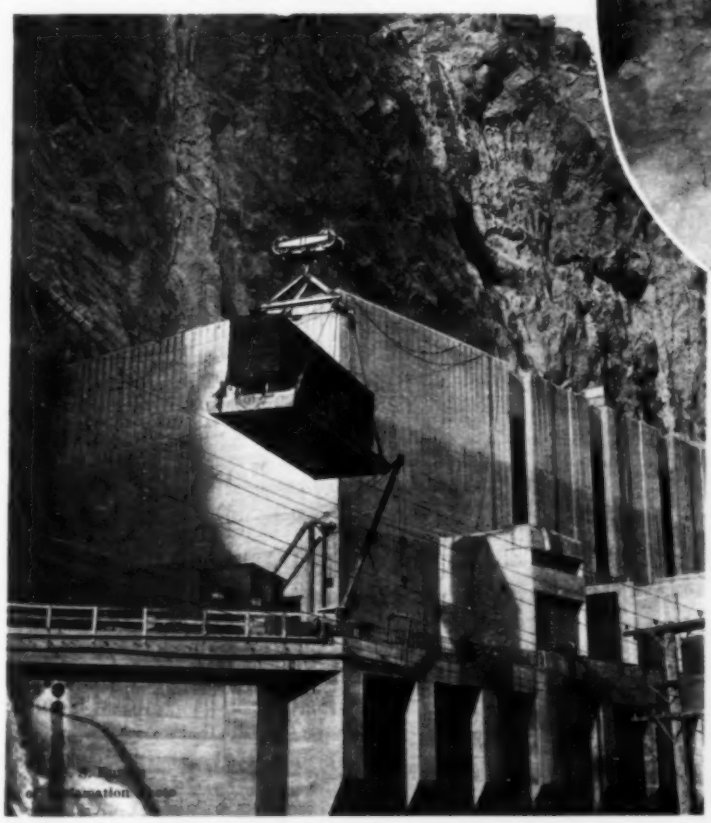


"HOLING THROUGH" CAKE, measuring 2x3 ft. in plan and weighing 100 lb., is baked in celebration of recent meeting of headings of West Iron Mountain tunnel of Colorado River aqueduct in California. Superintendent Ben Arp (*left*) of Utah Construction Co., accepts monster confection, shaped to represent tunnel portal, from Chef William Ketron.

LANDSLIDE on Lone Mountain, San Francisco, rips up pavement leading to San Francisco College for Women.

LOOKS LIKE SNOW (*left*) but actually this white, fluffy material is glass wool, an Owens-Illinois Glass Co. product for the insulation of buildings. Special process draws ordinary glass into fibrous form so fine that a single strand is only one-twentieth the diameter of a human hair.

MAMMOTH SLING (*below*) measuring 24 ft. long between loop eye bearings, has rated safe load capacity of 65.8 tons and breaking strength of 235.2 tons. Sling is made of Macwhyte wire rope braided to form flexible, non-kinking 8-part body.



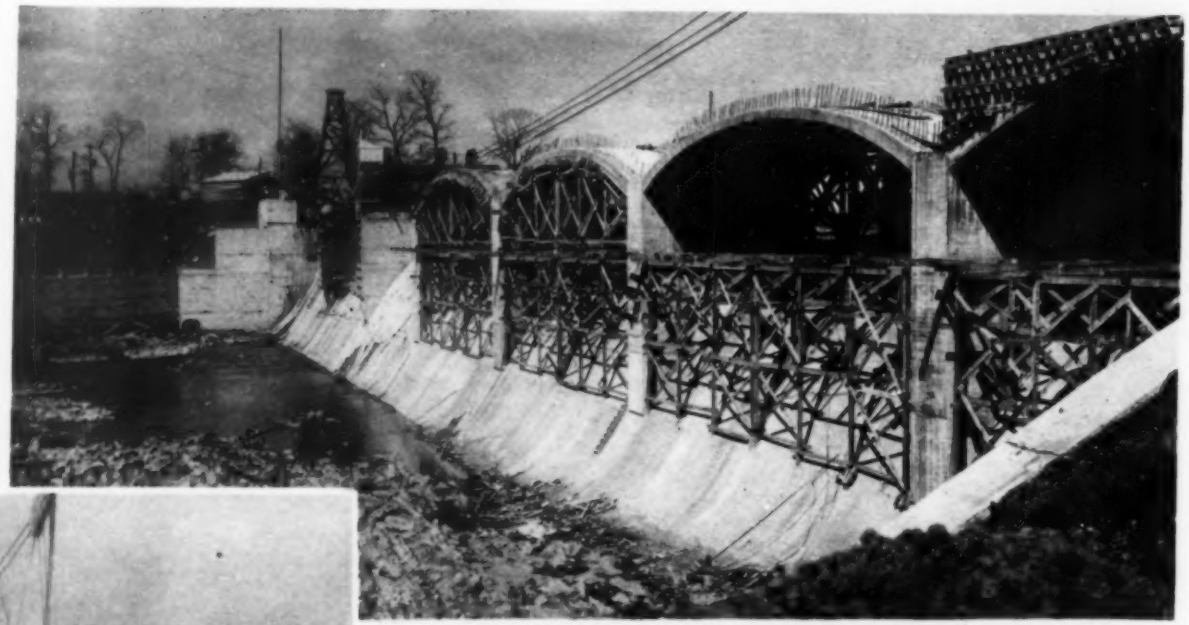
BOX CAR DOES TRAPEZE ACT. The 150-ton permanent cableway at Boulder Dam lowers loaded steel railway car 800 ft. down into Black Canyon to runway of power house on Nevada side.

Concrete Pump and Cableway

Serve Construction of

Spillway and Bridge

IN DESIGNING a plant to raise a 500-ft. concrete spillway and build a multiple-arch highway bridge across it at Ontelaunee dam for the Bureau of Water of Reading, Pa., the Whiting-Turner Contracting Co., of Baltimore, Md., holder of a general contract for the work valued at $167,000, determined upon a combination of concrete pump and 4-ton overhead rope tramway as the most economical equipment for the job. Including 1,500 cu. yd. of concrete in an extension of a retaining wall at one abutment, the contract called for a total of 12,000 cu. yd. to be placed in monolithic blocks ranging up to a maximum of 345 cu. yd. in the spillway. Storage requirements for sand and stone necessitated placing the batching plant a short distance from a 1-yd. mixer and concrete pump at one abutment, with a narrow-gage track for a hand-pushed batch car connecting the two locations. After initial difficulties with plugs in the pipe line had been overcome, the concrete plant maintained a consistent placing rate of about 22 cu. yd. an hour.

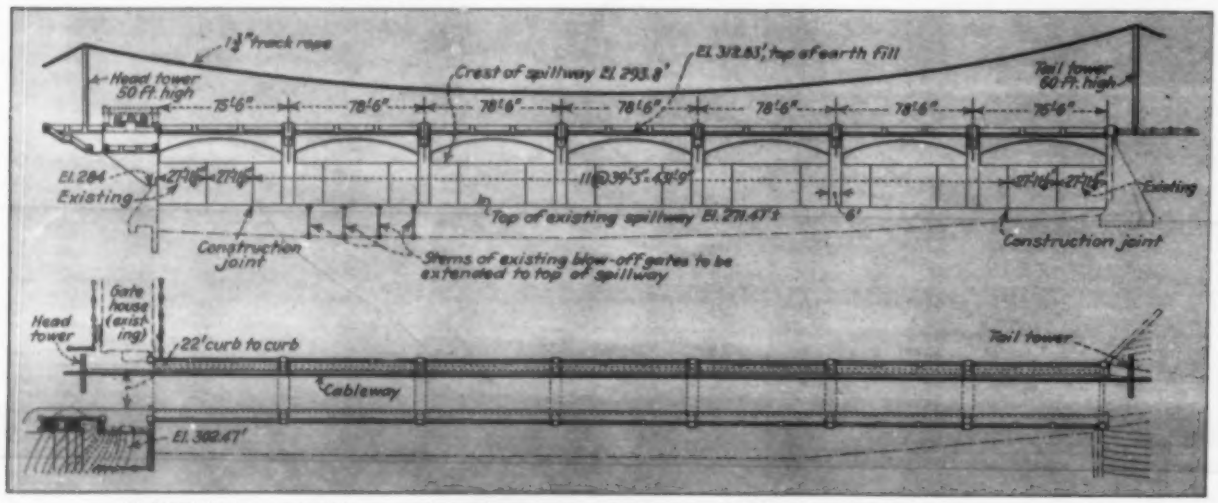


CONCRETE SPILLWAY 500 ft. long is raised 22 ft. and multiple-arch highway bridge is constructed across it with aid of cableway and concrete pump. Latter unit is situated directly under mixer to be seen in far abutment.

7-IN. PIPE LINE from concrete pump conveys material across length of spillway and delivers it to first monolithic block of raised spillway, in foreground.

Spillway and Bridge—Raising the spillway of Ontelaunee dam was one part of Reading's $2,500,000 program, financed by a municipal loan and a grant from the Federal Emergency Administration of Public Works, to make available 20,000,000 gal. a day of filtered water for present and future needs of the city. A dam to store drainage from the Maiden Creek watershed originally was constructed at this point in 1926-27. The spillway at that time was completed to El. 271.47, with provision for the present 22.33-ft. addition to El. 293.80.

As part of the program, a portion of one of the state's secondary roads which will be flooded by the reservoir has been relocated along the crest of the dam and across the spillway. This road crosses the spillway on seven earth-filled barrel arches of 72½-ft. clear span. The piers of the bridge are 24½ ft. wide and 6 ft. thick; they rise about 9 ft. above the crest of the spillway. The spillway itself, of standard Ogee section, measures 543½ ft. long between abutments. Of this length, two 28-ft. sections next to the abutments had been completed in 1926, leaving 487½ ft. to be filled in under the present contract.

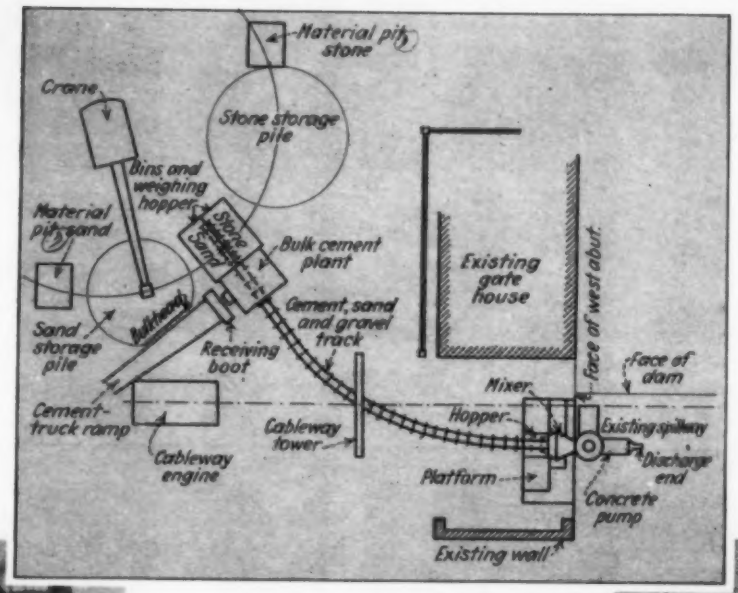


CABLEWAY stretched between timber-bent towers 620 ft. apart handles forms and reinforcement in loads up to 4 tons for spillway and bridge.

Selection of Plant—In designing a plant for the job the contractor originally gave consideration to: (1) a trestle bridge for crane operation, (2) a large-capacity cableway to handle concrete as well as forms and reinforcing steel, and (3) a light cableway in combination with a concrete pump. The choice quickly narrowed down to the last two possibilities. Although the Whiting-Turner organization never had used a concrete pump, it had been favorably impressed by observation of the equipment on other projects. The spillway contract presented an ideal situation for use of a concrete pump.

Large volumes of concrete could be placed with only minor changes in the pipe line during continuous pours. A second pipe line could easily be laid to deliver concrete from the central plant to the downstream extension of the abutment wall. With a pump to take care of concrete, a light, low-speed cableway would be adequate to handle forms and reinforcing steel.

To depend solely on a cableway to take care of all operations would have required a large-capacity overhead system capable of operating at high speeds. The size of the contract did not warrant a double-track cableway, and the handling of forms and steel necessarily would have ceased during concrete pours. In the final analysis the combination of concrete pump and light cableway, which could function simultaneously, offered the best solution.

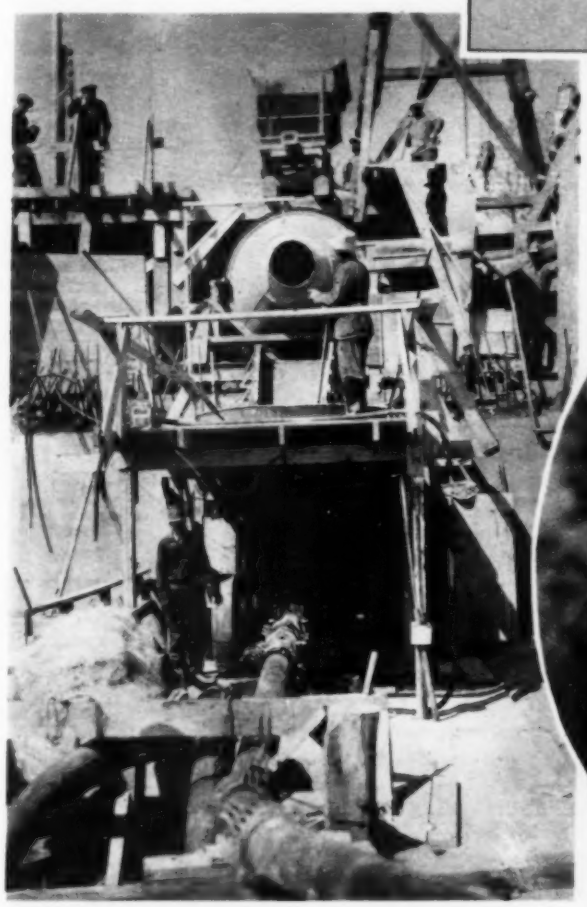


Conditions at Site—In locating the batching and mixing plant the only available site was at the west abutment, where the spillway connects with the creek bank. Favorable positions for the mixer and concrete pump (at two levels below the top of the bank) were offered by the completed short section of spillway and by a notch in the abutment wall above the haunch of the projected arch of the highway bridge. Lack of storage space, however, made it impossible to place the batching plant at this point, immediately above the mixer location.

Rather than set the mixer and concrete pump back into the bank under the batching hoppers, the contractor elected to use the natural existing locations for the mixer and pump and to transport dry batches from the hoppers to the mixer in a bottom-dump car on a narrow-gage track laid at a slight downgrade in the loaded direction. Three men pushed the car, which traveled a total distance of 20 mi. (divided between two shifts) in delivering batches for a 345-yd. pour.

An ingenious method was devised to support the concrete pump on the downstream slope of the existing spillway section. The engineers would not permit the drilling of any holes for anchor bolts in the downstream face of this section, but they did allow holes to be sunk in the upstream face, which will be covered with water. Accordingly the contractor placed steel straps across the crest of the spillway and anchored them by bolts grouted in the upstream face. The straps carried riveted steel brackets, filled with wood cores, on which rested the timber posts supporting the platform under the concrete gun. This detail is shown in an accompanying drawing.

Concrete Plant—Sand, crushed hard blue limestone rock, and bulk cement were delivered to the batching plant by truck under contract arrangements which included delivery to the site in the purchase price of the materials. Cement was dumped into a hopper from which it was taken by screw conveyor and bucket elevator to the 250-bbl. overhead bin of a Butler bulk-cement plant. Sand and stone were dumped into pits from which they were transferred by a Lima crane operating a 1-yd. clamshell bucket to 50-ton aggregate bins or to stockpiles. Both cement and aggregate were weighed by manually operated beam

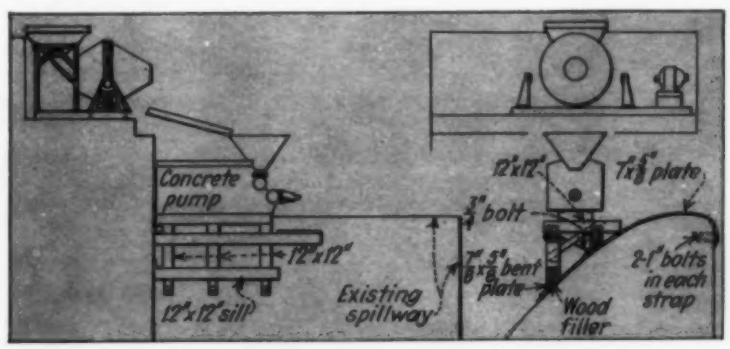


VERTICAL ARRANGEMENT of concrete plant enables dry materials to pass from batch car into track hopper and thence into drum of tilting mixer. Mixer empties into charging hopper of single-chambered concrete pump.

BATCHING PLANT is located at short distance from mixer to allow space for storage of materials, delivered to plant by trucks. Narrow-gage track connects batching set-up with mixer.

L. N. PHILLIPY, superintendent, directs work for Whiting-Turner Contracting Co.

FLEXIBILITY OF PIPE LINE permits rapid changes in points of delivery of concrete. In this instance, pipe is carrying concrete across bridge pier form work to spillway block in foreground.



CONCRETE PUMP rests on timber platform supported on brackets of strap plates anchored to upstream face of dam. Contractor is prohibited from drilling holes in downstream slope of structure.

scales equipped with visible dial attachments to indicate the final increment of desired weight and assist the operator in accurate closing of the gates. As shown on the plant layout, the bins and weighing hoppers were placed in line above the narrow-gage track. Materials for a 1-yd. batch were weighed and discharged from the aggregate hopper and cement hopper in turn into a Koppel radial-gate car.

At the lower end of its run the car dumped the dry batch into a track hopper which charged a 1-yd. Smith tilting mixer driven by electric motor. Concrete passed from the mixer down a short chute to the charging hopper of a single-chambered Rex Pumpcrete unit, powered by gasoline motor.

Pumping Concrete—As is normally the case when an organization first utilizes an unfamiliar mechanical process for which men have to be specially trained, the field force experienced some difficulty in pumping concrete during the period of learning the new technique. The pump itself gave no trouble, but repeated plugs in the pipe line caused delays in placing concrete. According to the men on the job, the plugs resulted from introduction of air or obstructive objects in the line and occasionally from passing a batch that was either too dry or too wet. In the case of a wet batch, segregation in the line sometimes caused a plug of coarse aggregate to form.

A principal cause of plugs was the occasional occurrence of rock slivers 8 and 9 in. long in the 2½-in. coarse aggregate originally specified for the mass concrete in this spillway section. These long slivers were thin enough to work their way through the 2½-in. screens. At the contractor's request, the engineers permitted a reduction in the size of aggregate to 2 in. The 2-in. screens rejected all rock slivers long enough to cause trouble in the 7-in. pipe line. As the men learned to prevent introduction of air by keeping the concrete in the charging hopper at a safe level and became familiar with the characteristics of the pump and pipe line, trouble with plugs ceased.

Because of weather and working conditions, it sometimes was impossible to remove and clean a plugged line until a day after the plug had formed. In these cases a second line was laid to continue the concrete placing. To clean the 10-ft. lengths of pipe after the concrete core had set, the contractor drilled a hole through the center of the core from end to end of each piece and heated the pipe by placing it on a fire. After a piece of pipe had been heated, it was up-ended by the crane and tapped on the outside with a hand hammer. The entire core then dropped out of the pipe.

One of the factors which recommended concrete pumping to the contractor was the ease of laying a pipe line in any position for starting a new pour. Little time or labor was involved in this preparation for placing concrete. In addition, the facility with which pipe joints could be made or broken by means of the toggle couplings aided the distribution of concrete within a monolithic block and reduced delays to a minimum when changing the flow of concrete from one part of the block to another.

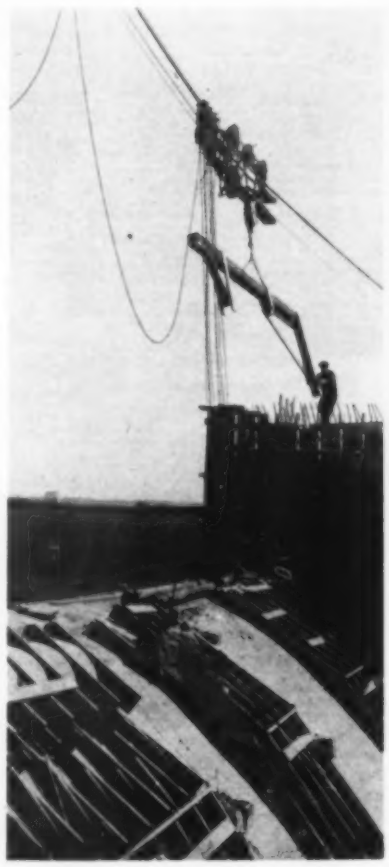
Cableway—Two drums of a Flory three-drum steam hoist engine operated the cableway, which had a 1¾-in. track rope strung between timber-bent towers 620 ft. apart. The cableway was equipped with a Flory carriage and slack carriers and was designed for a 5-per cent sag under full 4-ton load at the center of the span. Head and tail towers were 50 and 60 ft. high, respectively, to enable the cableway to carry arch centers across the top of completed arches. To facilitate picking up arch centers after stripping the cableway was erected off center, 2 ft. from the upstream face of the dam.

Formwork—Sectional wooden panel forms were used for the spillway and bridge piers. As required by specifications, forms for exposed surfaces were lined with 28-gage galvanized steel plate. The panel forms on the dam were used six times.

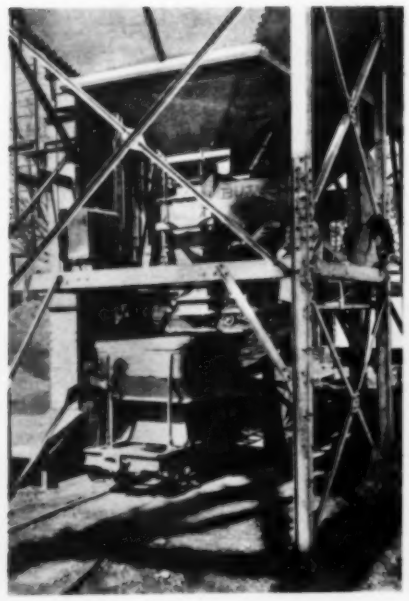
Arch ribs were concreted in two halves of 12 ft. each. Centering for each arch consisted of two longitudinal trusses which were used under one-half of the rib and then were moved over for the second half. Specifications required that they remain in place 14 days after concrete had been placed. The contractor used four sets of centering.

Steps cast on the downstream slope of the spillway supported the bents on which the centers rested. As indicated on an accompanying sketch, the cap beams of the bents projected some distance from the upstream face of the spillway to carry the centers when they were moved clear of the arch to be picked up by the cableway.

Personnel—For the Bureau of Water of the City of Reading, Pa., A. R. O'Reilly is chief engineer, E. A. Elbert is resident engineer in charge of all construction work, and Carl Christman is assistant resident engineer directly supervising work at the spillway. Operations of the Whiting-Turner Contracting Co. were directed by L. N. Phillipy, superintendent, under the general supervision of G. W. C. Whiting, president.

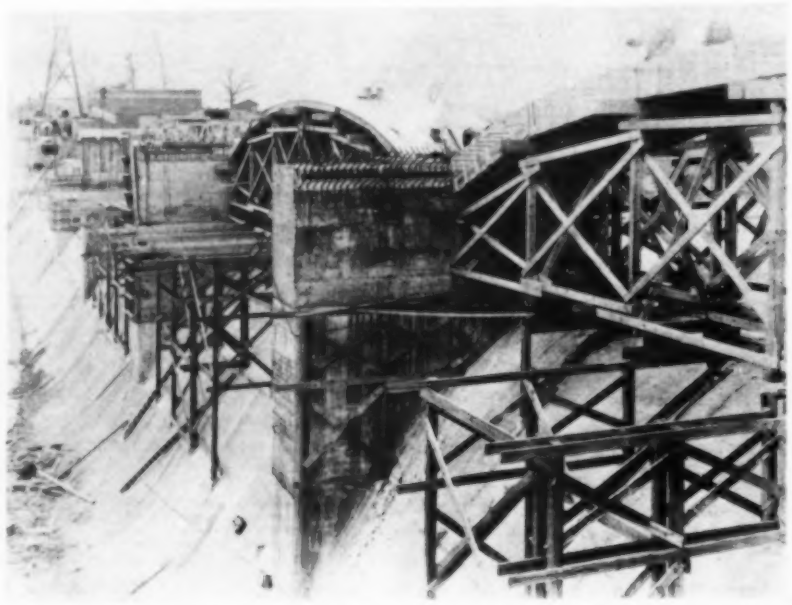


FALSEWORK BENT to support arch centers on sloping face of dam is carried by cableway across bridge pier.

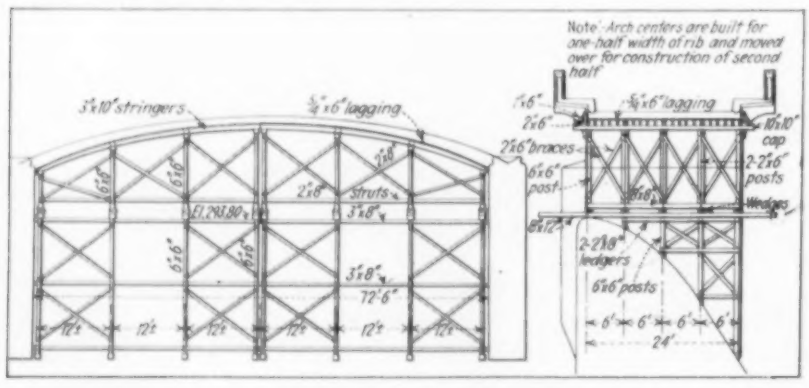


RADIAL-GATE HOPPER CAR on narrow-gage track receives batch of cement before starting down-grade trip to mixer.

CRANE-OPERATED CLAMSHELL handles sand and stone from dumping pits to stockpiles and to bins above car track.



ARCH CENTERS support half of concrete barrel arch during construction and then move over for placing of second half.



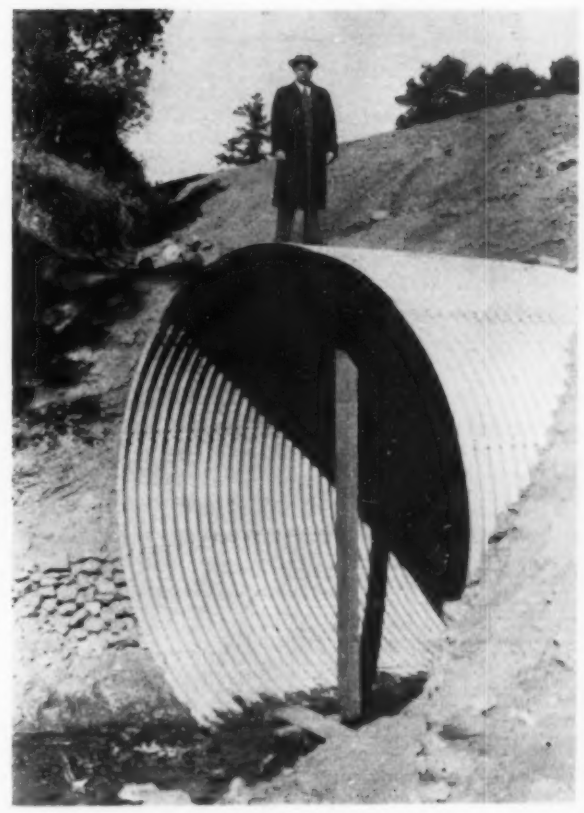
ELEVATION AND SECTION of timber falsework and centering used in building concrete barrel arches above spillway.

Step-by-Step Field Methods

Installing 15-Ft. Multi-Plate Waterway

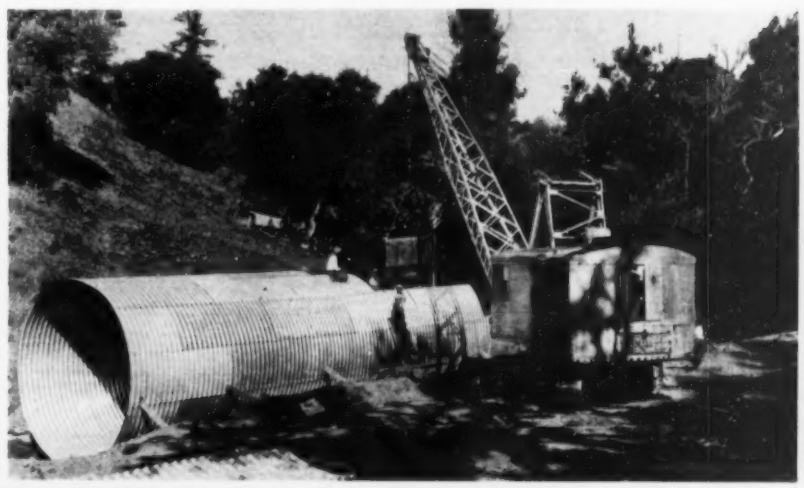
● The accompanying photographs illustrate the sequence of operations in assembling and installing a 15-ft. diameter Armco corrugated multi-plate waterway 85 ft. long under a new road at the head of Stevens Creek by the Santa Clara County Water Conservation District, California.

1 BEGINNING ASSEMBLY *(left)*. Galvanized plates of No. 1 gage are lowered by crane and bolted together. Chains and turnbuckles hold parts of circle in shape until entire ring is completed.

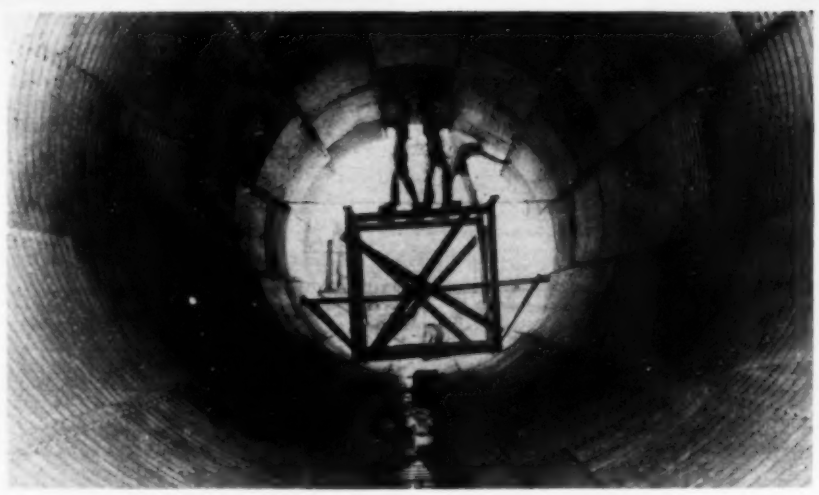


5 COMPLETED WATERWAY *(right)*, 15 ft. in diameter and 85 ft. long, is topped by 8 ft. of earth cover from fill that carries new roadway. Timber struts are removed after fill takes initial settlement and consolidates around pipe.

2 MOVABLE SCAFFOLD *(above)* aids erection and bolting of top plates of 15-ft. diameter ring while wooden braces support sides of huge waterway which will carry creek under new road at head of Stevens Creek.



3 CRAWLER CRANE *(above)* lowers to place a 500-lb. curved corrugated plate for the top portion of the 15-ft. ring. Total length of pipe is 85 ft.



4 BOLTS ARE TIGHTENED *(left)* by workers on movable scaffold inside pipe as assembly of multi-plates is completed.

Getting Down to

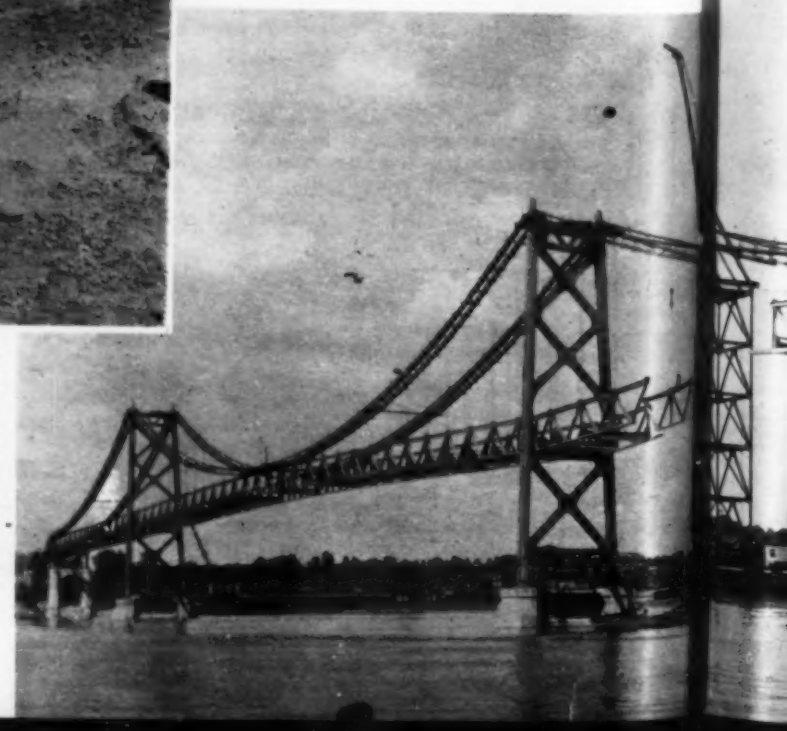
DETAILS

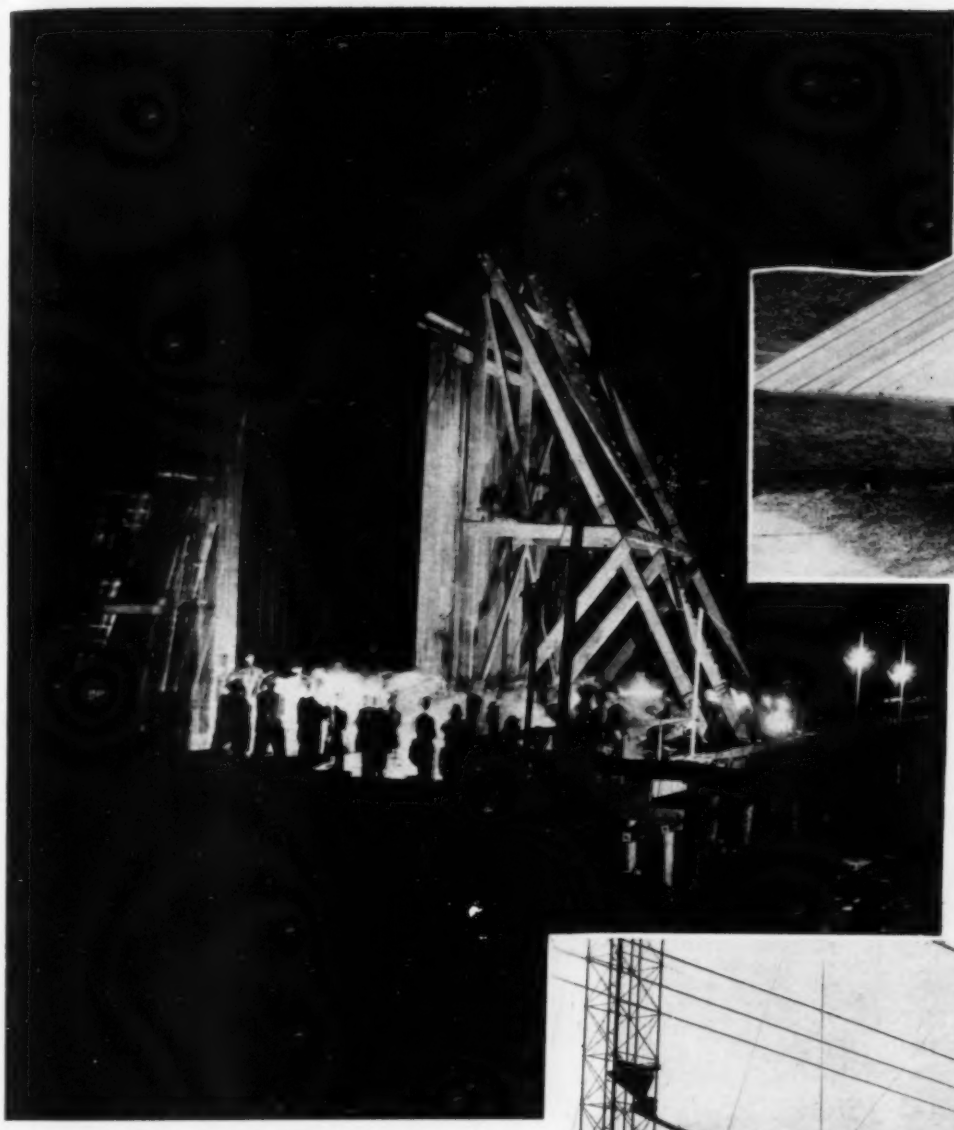
[Close-up Shots of Job Methods and Equipment]

RADIAL SQUEEZING JACK compresses 17,464 wires forming 28¾-in. diameter suspension cable for San Francisco-Oakland Bay bridge in California. Each cable consists of 37 strands of 472 wires held together by soft sheet metal bands. Traveling machine with chain drive brings to bear on strands pressure of six 75-ton jacks forming circle about cable and operated by compressed air motors. After compaction, cable is held in circular shape by temporary sizings or short spiral wrappings. Bands are bolted on to cables to supply grooves for hanging of suspender ropes to carry deck trusses for bridge roadway. After total dead load is applied, cables will be treated with red lead and wrapped with steel wire.

GLASS BLOCK PARTITIONS for offices are built like brick walls. Developed by Owens-Illinois Glass Co., translucent units, each weighing 3¼ lb., have dimensions of 5¾x5¾x3⅞ in. Blocks are handled by masons and are laid up in mortar, as illustrated. These blocks for interior partitions of office buildings are similar to the glass blocks for exterior walls of buildings, illustrated in *Construction Methods* last month.

PENETRATION NEEDLE determines proper compaction of earth fill being placed by M. E. Carlson, contractor, on Kenwood reservoir project for flood control on Cherry Creek, near Denver, Colo., A. K. Vickery, city engineer. Needle has spring scale reading in pounds and tip 0.1 sq. in. area. Fill is compacted until needle, slipping slowly into soil, gives reading of 700 lb. per square inch. Readings are taken in layer below top lift, according to K. C. Vail, materials engineer.

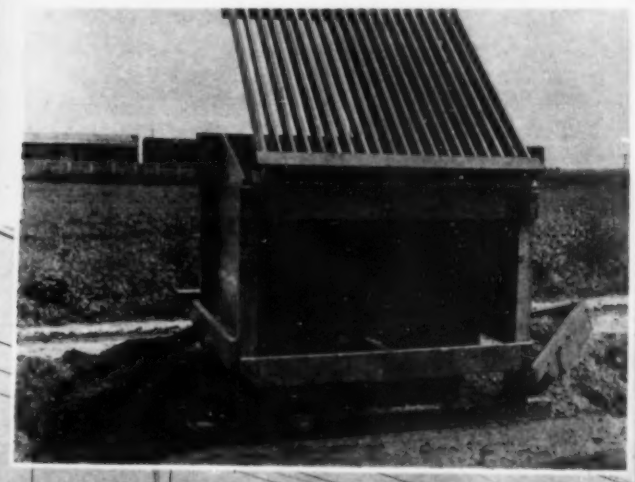


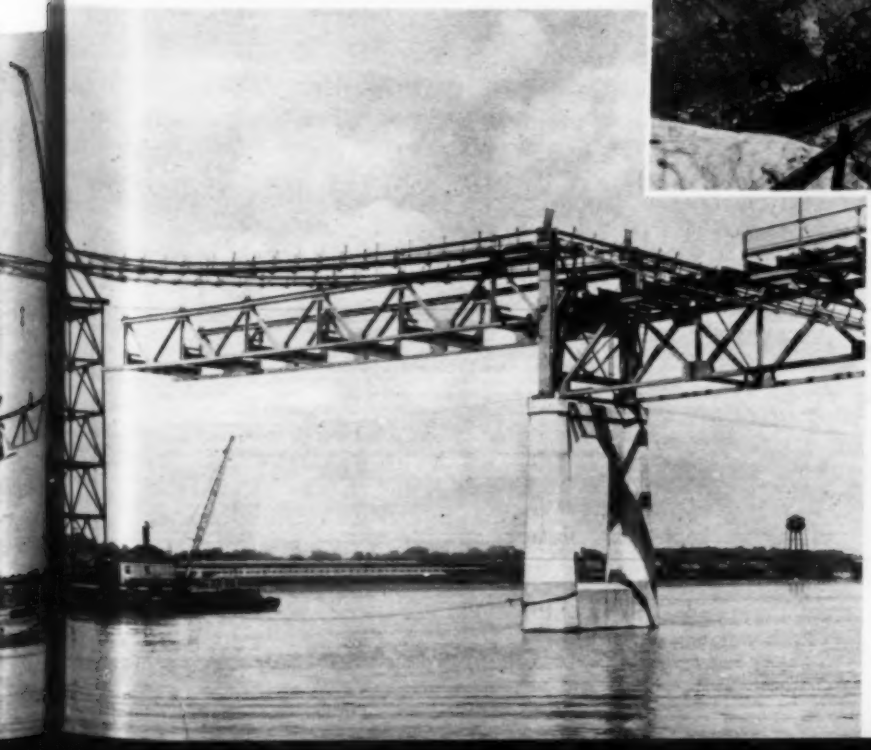


"PORTCULLIS," or gate of steel sheeting 45 ft. high and 50 ft. wide, is lowered into 20 ft. of water to make closure in last of three cofferdams built by Spencer, White & Prentis, Inc., contractors, of New York, to complete Mississippi River Lock and Dam No. 6 at Trempealeau, Wis. Closure made while ten tainter gates and 110-ft. wide lock were open. Portcullis was supported by stout timber trestle upon which three A-frames carried blocks and cables attached to hoisting engine. Steel sheeting driven against trestle closed in upon gate, causing swift current through open gap into which portcullis was dropped. Gate, overlapping opening 3 ft. on each side, was held vertical by bottom wale sliding against guide piles in platform below trestle. When gate reached bottom each sheet pile was driven home by floating piledriver.

FOR APPLYING TEST LOADS to concrete pavements in investigation of structural design by U. S. Bureau of Public Roads, steel tank 6 ft. in diameter and 30 ft. long is mounted on cradle spanning slab. Load of water admitted to tank is applied to pavement through movable wooden bolster or pad and ball-bearing screw jack.

FOR ADDING FINES (*below*), or 200-mesh material, to windrows for roadmix bituminous surfacing, Kansas Highway Department uses this special box which cuts trench in aggregate pile, deposits fines and covers them for protection against wind.

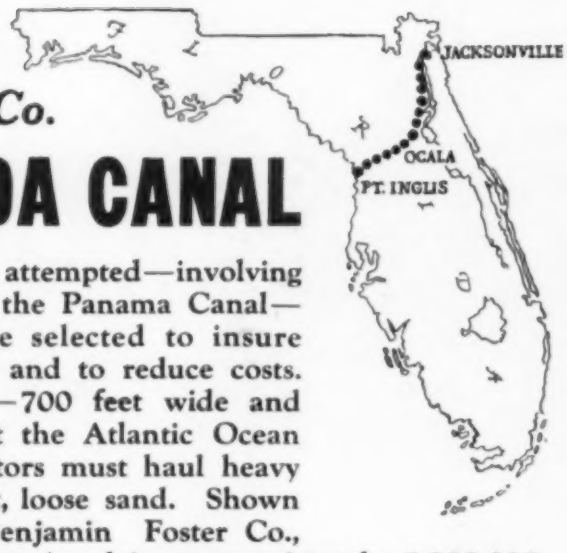




FLOATING TOWER DERRICK (*left and on opposite page*) erects towers, stiffening trusses and floor steel on new Mississippi River Bridge connecting Davenport, Ia. and Moline, Ill. Bridge has 740-ft. main suspension span and two three-span continuous truss units supported by seven piers, each span being 222 ft. long. Tower derrick is triangular in plan 33 ft. on a side and 112 ft. high above two steel barges on which it rests. On top of tower is 35-ton stiff-leg derrick with 90-ft. boom, capable of setting steel 200 ft. above water level. Derrick operated by three-drum steam hoisting engine and swing engine. Bridge superstructure erected by McClintic-Marshall Corp. under supervision of Modjeski, Masters & Case, consulting engineers.

CANVAS TENT (*above*) on timber frame covers about half of 171½x174-ft. floor slab at a time during winter construction by Buesching-Hagerman Corp., of Fort Wayne, Ind., of new 8,000,000-g.p.d. filter plant for Department of Water Works of Michigan City, Ind. Interior of tent is heated by coke-burning salamanders. Tower and chute deliver concrete to portable hopper for loading buggies.—*Photo from P. C. GALE, superintendent, Department of Water Works, Michigan City, Indiana.*

OK! WE'LL TAKE Allis-Cha



says Benjamin Foster Co.

ON THE FLORIDA CANAL

On the largest dirt moving job ever attempted—involving nearly twice as much yardage as the Panama Canal—Allis-Chalmers Oil Tractors were selected to insure completion of the work on time, and to reduce costs. On this gigantic 206-mile canal—700 feet wide and 30 feet deep—which will connect the Atlantic Ocean with the Gulf of Mexico, the tractors must haul heavy loads up 10 per cent grades in soft, loose sand. Shown here are some of the units of Benjamin Foster Co., holder of the largest single contract, involving approximately 5,000,000 yards. A fleet of Allis-Chalmers Model "L-O" Oil Tractors keeps the dirt moving at high speed—with such obvious advantages as instant starting, simplicity of design and less maintenance—due to the low compression system employed in A-C Oil Engines. Allis-Chalmers Wagon Tracks were also chosen—they are mounted on rollers and will resist the grinding wear of sandy conditions. Just as A-C Oil Tractors are setting the pace on the world's largest job—they will set the pace for cutting costs and increasing production on YOUR job.

LOW COST DIESEL FUEL

Allis-Chalmers Oil Tractors have the exclusive advantage of gasoline tractor simplicity combined with Diesel Fuel economy. Low compression means instant starting and less maintenance.

NO. 14 LOADS UP. A fleet of fast-stepping "L-O'S" keeps the shovels busy as the Florida Canal gets under way. This is unit No. 14 of the Benjamin Foster Company fleet. Allis-Chalmers wagon tracks—mounted on rollers—stand up in the sand.

BRANCH HOUSE AND DEALER SERVICE

In addition to a wide-spread dealer organization, extending from coast to coast, Allis-Chalmers has factory branches in every territory to provide A-C owners with prompt, efficient service—UNDER FACTORY SUPERVISION.

ALLIS-CHALMERS OIL TRACTORS

TRACTOR DIVISION—MILWAUKEE, U. S. A.

LABOR RATES AND RESTRICTIONS AS THEY AFFECT CONSTRUCTION COSTS

By ARTHUR A. JOHNSON

President, Arthur A. Johnson Corp., Long Island City, N. Y.

AN ADDRESS, *slightly condensed, delivered to the Department of Civil Engineering, New York University.*

ANY CLASSIFICATION of labor in the construction industry should clearly differentiate between those employed on building work and those engaged in engineering construction, railroad and highway work. For almost 200 years building work has always been under the direction of the architectural profession which has developed a technique in procedure that distinctly sets it apart. On the other hand, engineering construction has been under the direction of the engineering profession which has been compelled to develop its own technique and procedure as new methods and demands have arisen.

This distinction is due to many reasons, chief of which is that the general building contractor usually does only a small percentage of the work with his own forces and sublets the major portion to a number of specialized contractors who follow one another in sequence. The various subdivisions of the building industry are highly specialized as compared with the engineering construction field. This is more clearly borne out by the fact that on Nov. 15, 1934 (under NRA) there were 16 approved divisional codes, excluding the one for general contractors. Of these, 15 apply to the building industry and only one to the engineering field. These divisions perform only a certain defined part of the work, use workmen who do nothing else and depart. Very little of their work, except hoisting material, is done by machinery. In fact the hoisting of material is the only outstanding improvement in the building construction field, above foundations, in the last 50 years.

Engineering construction, which includes railroad and highway work, is very different. The contractor must visit the site of the project, frequently in unpopulated districts, draw his own conclusions as to nature of the work, class of materials that will be found, hazards that may be expected, class and amount of labor that will be employed. Individual projects frequently involve an estimate of financial conditions that will exist in the future, as projects lasting four years and longer are not uncommon.

Only in rare cases are there jobs of the kind where the work of one trade could be finished and another follow in sequence, as is customary in building work. Generally, all classes of work are going on at one time, in one place and under one direction. The work is mostly of a rough nature, is quite frequently hidden from sight and does not require the skill of an artisan for execution, as is the case in most buildings. With the two classes of work differing so greatly, it is obvious that the labor classifications should also differ. The attempt which is being made today to impose upon general construction the labor classification by trades and rates of pay as it exists in the building industry will, in my opinion, be fatal to the industry and a great handicap to recovery in the country.

Simply because a laborer on engineering construction is referred to by the same name and may use some of the same tools as one in the building industry, it does not mean he has the same degree of skill or that the same degree of skill is required. Take, for instance, a carpenter. In both branches of the construction industry all men who use wood-working tools now are classified as carpenters, but it is ridiculous to say that a highly skilled artisan who can place the trim in a building, or build a cabinet, is the same kind of a carpenter as the one who puts together the rough forms required for concrete construction. It must be equally ridiculous to say that the second carpenter should be paid as high a wage as the first one. The same differential applies in almost every trade in the construction industry.

Another essential difference between labor employed in building work and in engineering construction is that there are so many operations proceeding simultaneously in engineering construction that it is impractical for an employer to have a different man for every trade, as is customary in building work. In building work the trades are clearly defined, following one after the other in sequence, but in engineering construction it is extremely difficult to say to what trade a certain piece of work, requiring, perhaps, only 10 min. of work per day, should be allotted.

Let us consider labor involved in the construction of New York City subways. This work consists of simultaneously underpinning foundations of buildings; of placing street decking to carry vehicular and pedestrian traffic while construction underneath is progressing; of excavation of trench in which structure is to be built; and of construction of the structure itself, which usually consists of a steel skeleton with very light concrete arches supported by the steel.

The amount of reinforcing steel used in the concrete of a subway section is usually very light. Until about a year ago this reinforcing steel was always placed by the men who built the rough concrete forms, and obviously so because, in most cases, the reinforcing steel had to be placed while the forms were being erected, the concrete being so thin that it would be impossible to get between the forms and the sides of the trench to erect the steel after the forms were built. Moreover, the actual placing of the reinforcing steel could not consume more than 2 hr. of the working day used in the building of the forms.

From 1925 to 1932, a period during which the mammoth City-owned subway was built in New York, reinforcing steel bars were always placed by the men who built the wood forms. Now we have an entirely different condition. Labor unions, which have always been engaged in performing a certain defined part of the construction of buildings, have been successful in their demands that various operations of subway construction be done by their organizations. For instance, the contractor has been forced to allot the placing of reinforcing steel to the Metal Lathers' Union.

This union's charter provides that its members shall do all the work of lathing, placing of wire-mesh under plaster, etc., in buildings, but during the last several years they have usurped the placing of reinforcing steel in building operations and have now succeeded in their demands that members of this union place reinforcing steel in engineering construction. We have the condition in subway construction, therefore, that carpenters belonging to one union organization will have to build the concrete forms and, for a very short period in each day, workmen of an entirely different organization, the Metal Lathers' Union, will have to be brought in to erect the reinforcing steel. Not only does this bring about a tremendously increased cost, owing to the breaking of the continuity of the work, but during the period from 1925 to 1932 the men employed in placing of reinforcing steel were paid at the rate of 80c per hour, whereas the rate of the workmen in the Metal Lathers' Union is $1.40 per hour, an increased labor cost of nearly 70 per cent.

Let us take another instance — the placing of concrete for side walls and roof, which is done by workmen classified as laborers. It is generally necessary that timber braces supporting the sides of the excavation be removed as these side walls and roof are constructed. Under union rules and regulations, however, the removal of these timbers cannot be done by the men who are placing the concrete; other men must be brought in, members of the Timbermen's Union. While they are removing the timbers the concrete-placing gang must either remain idle or be moved to another location, obviously increasing the cost.

Craft vs. Vertical Unions—I have referred to these examples of interference with the continuity of the work so as to lead up to a comparison between "craft" unions and "vertical" or industry unions. In a craft union the members are permitted only to perform work in the particular craft or trade for which the union is organized, whereas in a vertical or industry union the worker can perform any work in that industry for which he is qualified, providing he is in good standing in his union and is paid at the rate agreed upon through collective bargaining for the particular item of work.

It is easy to see why there are so many costly strikes of a jurisdictional nature in any industry controlled by craft unions. Such strikes are costly to the worker, the employer, and the public. Unfortunately, the employer, the public, and, most frequently, the individual worker are innocent victims of the controversy; they have to sustain unjustly the cost of a frequently stupid and almost childish argument, in which they are not a party and with which they have nothing whatever to do. To emphasize the stupidity of craft unions in construction I quote from the October issue of the official publication of the Building Trades Employers' Association of New York:

"There are such peculiarities as the requirement that one union can drill holes up to ⅜ in., but ½-in. holes have to be bored by another union. Putting up a plain base board is one union's work. However, if the same board for the same purpose has a certain groove in it, another union claims this erection.

"Three unions recently engaged in considerable controversy, each claiming the exclusive right for its workers to erect the identical building material. A shield fixed to a radiator is the work of a steamfitter. If

not attached to the radiator it must be erected by sheet metal workers. Flat face tile laid in mortar is a bricklayer's job, laid in asphalt it is a roofer's task. These are but few of a volume of examples which can illustrate the crazy-quilt nature of the crafts union structure in the building trades."

Craft unions have long been the established method of labor organization in the building trades, but even in this branch of the industry where one skilled trade can follow another in sequence it has been found that this type of organization has developed into 55 separate unions which have to be dealt with in the construction of a building. The rules, regulations, demands, wage and hours disputes and jurisdictional difficulties of more than half a hundred unions are seriously hampering building industry progress. It must be apparent when it is so clearly demonstrated how the craft system of unions hampers the building industry, how much more impossible it is to use this system of labor organization for engineering construction, when almost all operations are interrelated, must proceed at one time, in one place and under one direction.

It is my sincere belief that men engaged in engineering construction should have the right to organize and bargain collectively with their employers, but I believe the method of organization must be entirely different from that which is prevalent in the building trades. I believe that the organization of labor in engineering construction must be on the vertical or industry type, and as long as a man is in good standing in his labor organization he should be permitted to perform any kind of work for which he is competent, providing he is paid at the agreed rates of wages, determined by collective bargaining, for that particular kind of work.

The interests of the workman demand steady and continuous employment. If a workman is employed on a construction project, and, let us say, his work as a drillrunner has been completed, then he should have the right to continue working on that project in any other class of work which he is competent to perform, providing he receives the rate of pay which has been determined through collective bargaining. Otherwise, just as soon as his work of drillrunner is completed, he must leave this construction project and walk the streets until he finds another job. He is, therefore, barred from steady and continuous employment.

During the last few years labor organizations have succeeded in passing legislation in the State of New York which makes it almost mandatory now that the abnormal rates of wages hitherto paid only in building construction be applied to engineering construction. It is my opinion that this legislation is unwise and inequitable. These laws have been enacted from only one consideration, that of increasing the hourly or daily wages, or rather by bringing up the hourly or daily wage in engineering construction to the same abnormal height that has hitherto prevailed only in building construction. This has been done without regard for the fact that on building construction a workman does not work more than an average of 150 days in the year, whereas on engineering construction most projects run from one to four years of continuous daily employment. It is easily seen, therefore, that the annual wage on engineering construction will normally be twice, and possibly three times, as much as a workman could earn in building construction, placing a burden on the former branch which will retard its recovery and unfortunately retard the re-employment of a vast number of men.

Comparison of Cost of Labor on Subway Construction
FOR AVERAGE 8-HR. SHIFT

	At Previous Subway Construction Rates 1925-1932			At 6th Ave. Subway Rates 1935	
		RATE	TOTAL	RATE	TOTAL
2	Blacksmiths,	$ 11.20 day	$ 22.40	$ 11.20 day	$ 22.40
2	" helpers,	7.92 "	15.84	8.00 "	16.00
2	Blasters,	12.00 "	24.00	13.20 "	26.40
1	Bricklayer,	11.20 "	11.20	12.00 "	12.00
1	" helper	6.00 "	6.00	.90 hr.	7.20
1	Caulker,	1.00 hr.	8.00	1.15 "	9.20
1	" helper,	.65 "	5.20	.68¾ "	5.50
20	Truck drivers,	.75 "	120.00	.87½ "	140.00
10	Spademen,	.55 "	44.00	1.10 "	88.00
4	Portable compressor operators,	.80 "	25.60	1.12½ "	36.00
2	Concrete Finishers,	.80 "	12.80	1.40 "	22.40
25	" laborers,	.60 "	120.00	.68¾ "	137.00
1	" mixer tender,	.75 "	6.00	1.12½ "	9.00
4	Concrete spaders,	.60 "	19.20	.68¾ "	22.00
20	Dock builders,	1.00 "	160.00	1.40 "	224.00
4	Duct layers,	1.00 "	32.00	1.50 "	48.00
2	Electricians,	11.00 day	22.00	1.40 "	22.40
1	" helper,	.75 hr.	6.00	.95 "	7.60
6	Apprentice engrs.,	1.00 "	48.00	1.12½ "	54.00
3	Shovel engrs.,	1.65 "	39.60	1.75 "	42.00
6	Crane engrs.,	1.40 "	67.20	1.65 "	79.20
2	Derrick "	1.31¼ "	21.00	1.65 "	26.40
1	Stationary "	1.31¼ "	10.50	1.50 "	12.00
3	Truck Crane "	1.40 "	33.60	1.65 "	39.60
4	Form Builders,	1.40 "	44.80	1.40 "	44.80
40	" Erectors,	.80 "	256.00	1.40 "	448.00
25	Drill runners,	.80 "	160.00	1.10 "	220.00
120	Laborers,	.55 "	528.00	.68¾ "	680.00
2	Machinists,	1.00 "	16.00	1.12½ "	18.00
1	Auto "	.90 "	7.20	1.12½ "	9.00
10	Pipemen, pumpmen, burners, etc.,	.80 "	64.00	1.12½ "	90.00
1	Powder Watcher,	.62½ "	5.00	.68¾ "	5.50
2	" monkeys,	.62½ "	10.00	.68¾ "	11.00
1	Sawfiler,	.80 "	6.40	1.40 "	11.20
14	Steel erectors,	1.65 "	184.80	1.65 "	184.80
8	" bolters-up,	1.37½ "	88.00	1.65 "	106.60
40	Timbermen,	.80 "	256.00	1.00 "	320.00
10	Waterproofers,	1.28½ "	102.80	1.28½ "	102.80
		Totals	$ 2,609.14		$ 3,359.00

Comparative Costs—I have prepared the accompanying table showing the average cost of labor for an 8-hr. day on a medium-sized subway contract between the years 1925 and 1932, and alongside have shown the cost of the same average labor per day at rates determined under the laws of the State of New York for the construction of the Sixth Avenue subway, bids for which were received recently.

A comparison of these costs shows that the labor cost of a typical shift from 1925 to 1932 was $2,609.14, whereas the cost of the same labor for a shift building the Sixth Avenue subway will be $3,359.00, which is an increase of 28 per cent. If the Sixth Ave. subway costs $35,000,000 the local direct labor will be about 50 per cent. Therefore, the direct labor will cost about $17,500,000 which, at 28 per cent increase, shows that the additional labor cost on this extension of the subway will be about $4,500,000. Between 1925 and 1932 only the skilled trades, such as engineers, bricklayers, steel erectors, etc., were organized labor, the remainder of the workmen being semi-skilled and unskilled and unorganized. It is now apparent that every man on subway construction will have to belong to a labor union and agreements between the employers and the workmen are now being negotiated.

I do not want to give the impression that I am adverse to high wages, to increase in wages or to organized labor, because my record shows that my thoughts are just the opposite. Yet it has always seemed fundamental to me that if wages are increased without regard to the economic value of the finished product, then the result must be a penalty not only upon the owner, but more particularly on the workers in the industry. The inevitable result of such a practice is a curtailment of activity in that industry, with resulting enforced unemployment.

This is very clearly demonstrated when you consider the building industry. Everybody knows what has happened to the greater number of large buildings that were erected at the abnormally high prices between 1924-1930 in every large city in the United States. Almost all of these buildings have been deflated, the excess costs squeezed out, and they are now carried on the books of the owners at from 40 to 50 per cent of the cost of production. Even at this deflated valuation few of them are able to meet all the charges for interest, taxes, administration, etc., out of income.

From 50 to 60 per cent of this original cost is represented by defaulted bonds and mortgages which have been forever lost to the investors. Yet, today, the highly organized building trades employees demand not only the same excessive wage rates, but, in some trades, are demanding still higher rates. When we take into consideration the further increased costs due to the restricted 30-hr. week of the PWA, and the 40-hr. week mandatory by State Law, we find that the labor cost of erecting a building today is approximately 125 per cent of the cost at the peak in 1929.

Under these conditions investors are invited to finance new buildings at a labor cost approximately 125 per cent of the peak boom prices, adjacent to existing buildings which are now valued and carried on the books at from 40 to 50 per cent of the same peak prices when these latter buildings are not able to make an adequate return on the reduced valuation. And yet people wonder why building is at a standstill, why only from 10 to 12 per cent of the highly organized building trades employees are employed, with the resulting criticism that the construction industry is not leading us out of the depression.

I have used the building industry as an illustration. Exactly the same reason is applicable to explain the lethargy in other branches of the industry. Whenever the state or municipality or the Federal Government is even remotely interested in the project, short-sighted public officials stipulate that the abnormally high building trade wages, with all their allied retarding rules and regulations be applied to this class of construction, notwithstanding that from time immemorial classifications of labor have been different and rates of wages have been less for heavy construction, railroad and highway work than those used and paid in the construction of buildings.

It seems to me that the quickest solution of this condition must be for organized labor to declare at once at least a 33 per cent decrease in the rates of wages for a period of, say, two years, with the distinct understanding that after this, and as recovery takes place, these rates of wages are to be increased, say, 10 per cent per annum, providing the economic value of the finished product can absorb the increase. I believe that such an announcement by the leaders of organized labor would immediately start a boom in building and engineering construction throughout the country and instead of there being a meager 10 per cent of construction employees working at the present time, within a very few months this would be increased to 60 or 70 per cent.

THIRD OF A SERIES OF ARTICLES

Planning and Plant for

HEAVY CONSTRUCTION

Principles and Practices of Job Layout and Selection and Use of Equipment for Large Dams and Appurtenant Works

By ADOLPH J. ACKERMAN *and* CHARLES H. LOCHER
Construction Plant Engineer *Construction Consultant*
TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENN.

. . . 3 . . .

Preparatory Work
Shop Buildings
And Utilities

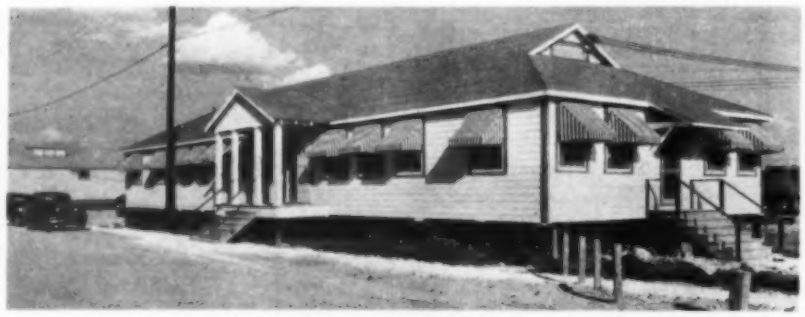
ENTERTAINMENT.—The provision of adequate entertainment facilities is even more important in a construction camp than it is in more diversified city life. This is chiefly because a large group of people are thrown together who see each other day in and day out for several years, and the job can suffer a considerable financial loss if the residents of the camp are permitted to devote all of their spare time to gossip and the formation of cliques and "mutual admiration societies."

A well organized program of entertainment and recreation in the camp is a good investment. The families of job officials can render valuable assistance along these lines, particularly if they have the ability to avoid the appearance of "running the whole show." For purposes of entertainment a first-class community building is desirable. It should include an auditorium for motion pictures and lectures; playrooms for billiards and cards; a library; several small rooms for group meetings or educational classes; and a refreshment stand, post office and similar facilities.

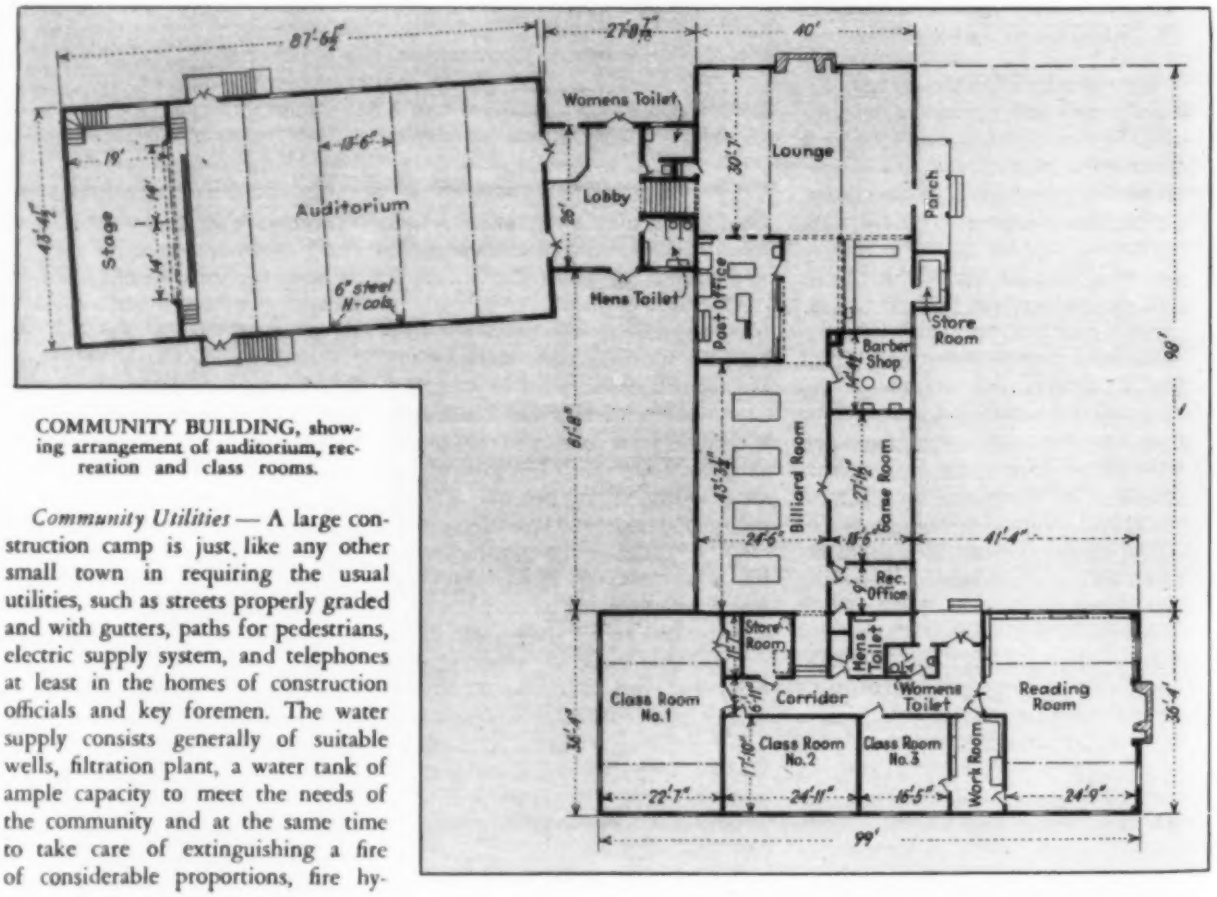
Other Camp Buildings—Other standard facilities of a large construction camp include a town office for administrative, police and fire protection headquarters, a school and church, and a first-class hospital.

The hospital deserves special attention. A rather common expression in the heavy construction industry is that one life is lost for every million dollars cost of the project. Frequently an extremely hazardous operation brings with it a much higher mortality rate. Under some compensation laws a life is valued at $20,000. Considering for the moment cold cash figures, if only one or two lives are saved as the result of having a first-class hospital, equipped to take care of practically any job contingency, the investment is worth while.

Sometimes the most desirable location for a hospital is at some distance from the center of construction operations. In such cases it is essential to erect a small first-aid station very near the center of operations, with a competent medical officer in attendance at all times to take care of emergency cases within a few moments after an accident has occurred.



TYPICAL JOB OFFICE BUILDING at Pickwick Landing dam.



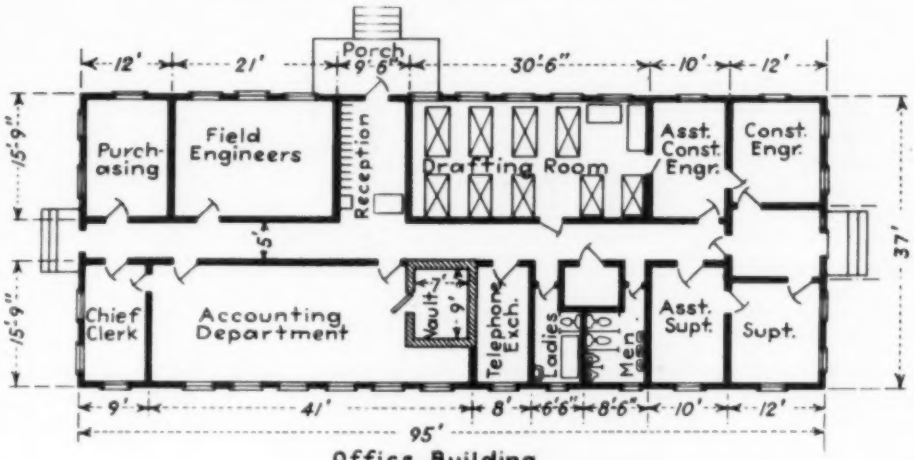
COMMUNITY BUILDING, showing arrangement of auditorium, recreation and class rooms.

Community Utilities — A large construction camp is just like any other small town in requiring the usual utilities, such as streets properly graded and with gutters, paths for pedestrians, electric supply system, and telephones at least in the homes of construction officials and key foremen. The water supply consists generally of suitable wells, filtration plant, a water tank of ample capacity to meet the needs of the community and at the same time to take care of extinguishing a fire of considerable proportions, fire hydrants properly spaced, and the entire underground system carefully mapped so that it can be relocated readily in case of repairs. An adequate sewage disposal system is required as a sanitary measure with a suitable but economical type of Imhoff tank and drying bed or other system of disposal. On a recent privately built job with a camp housing 1,500 men the water supply system consisted of a filter plant with a capacity of 150 gal. per min. The water tank stored 100,000 gal., and peak demands on the system reached 200 gal. against an overall average demand of 80 gal. per minute. The entire fresh water system for the community and raw water system for construction operations cost $120,000 and the sewage system came to $55,000.

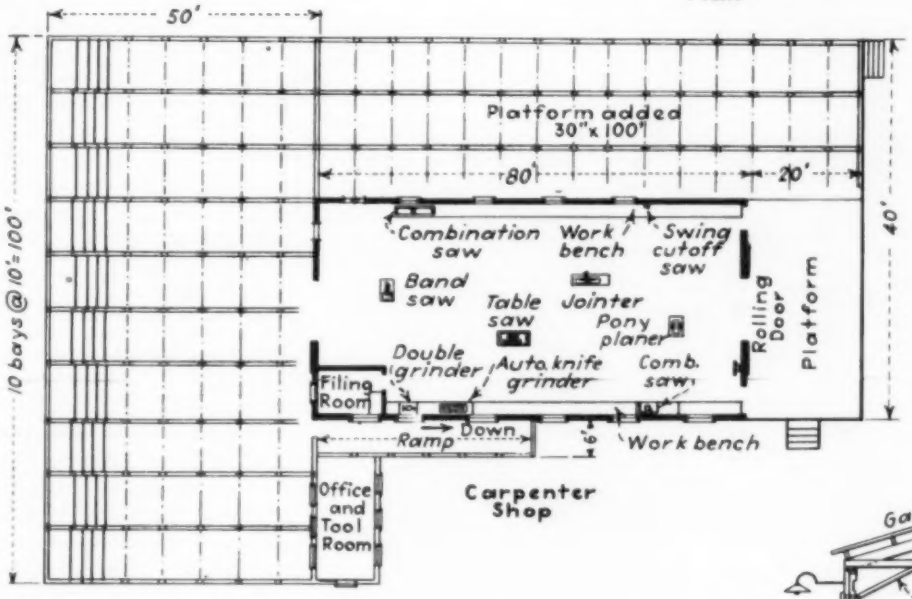
Finally, with the entire camp erected, reasonable consideration should be given to sodding the area, providing some shrubs, fencing, entrance gateways and similar landscaping features which go a long way in encouraging a healthy community spirit.

Future of Construction Camps—In urging upon constructors the provision of more livable camp and dormitory facilities it is desirable to point out that the construction industry and individual contractors should not be held responsible for all of the past objectionable camp conditions. The majority of contractors on a large project would be very happy indeed to provide the

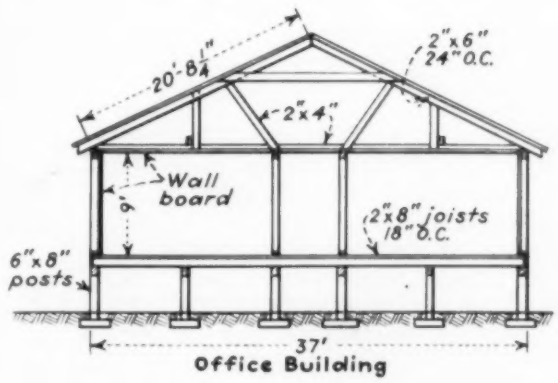
SHOP BUILDINGS



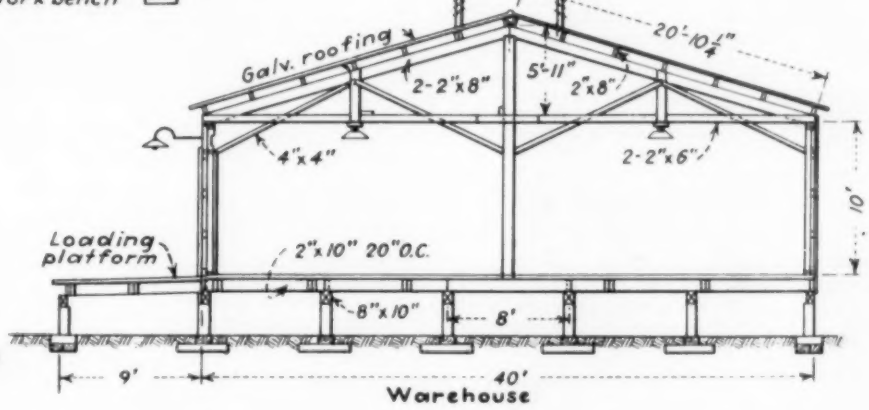
Office Building Plan



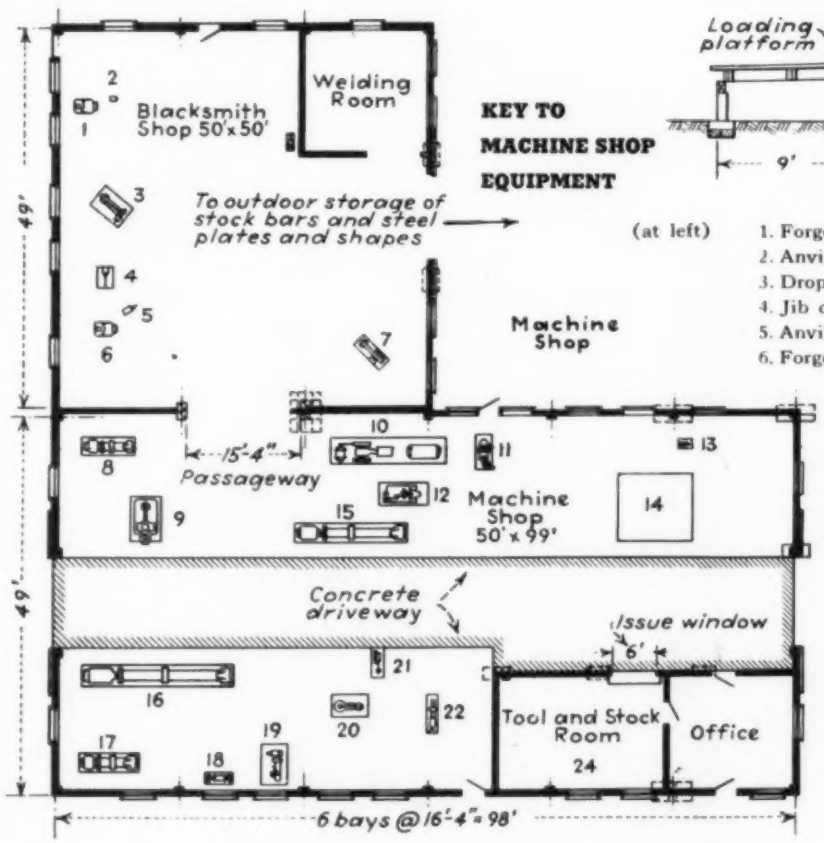
Carpenter Shop



Office Building



Warehouse

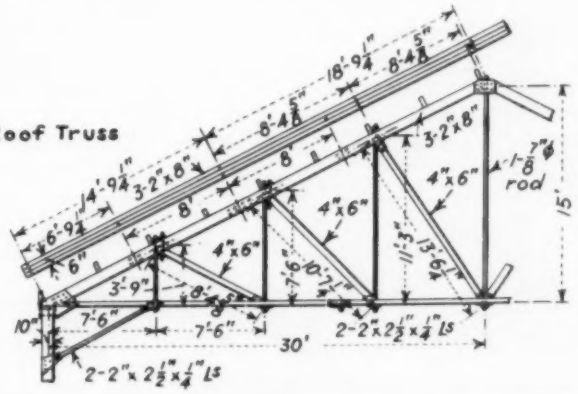


KEY TO MACHINE SHOP EQUIPMENT

(at left)

1. Forge
2. Anvil
3. Drop Hammer
4. Jib crane
5. Anvil
6. Forge
7. Power punch and shear
8. Lathe
9. Radial press
10. Air compressor
11. Pipe-threading machine
12. Bolt-threading machine
13. Rigger's vise
14. Layout table
15. Lathe
16. Lathe
17. Lathe
18. Grinder
19. Shaper
20. Drill press
21. Power hacksaw
22. Hydraulic press
23. Grinder
24. Grinder

Roof Truss



TYPICAL CONSTRUCTION CAMP FACILITIES

Type of Building	General Features	Purpose	Dimensions of Typical Buildings	Cost of Typical Units	Representative List of Installed Equipment and Facilities
Main Office	One or two-story; special windows and lighting, fireproof vault. Exterior—siding. Interior—composition board.	Offices for superintendent, engineers, chief clerk, accountants and purchasing agent. Also drafting and conference rooms.	115x37 ft. 9-ft. ceiling.	$11,000; 20c per cu.ft.	Office and drafting furniture; reception desk; telephone switchboard; 2 toilets; built-in vault; high- grade illumination; drinking fountain; fire extinguishers; supply closet; heaters.
Time Office	One-story; office space; "in" and "out" check windows.	Offices for paymaster, time-keepers and payroll clerks.	40x25 ft.	$2,800; 26c per cu.ft.	Office furniture; employee check racks; adding machines; files; toilets; heaters.
Employment Office	One-story; office space; reception room; toilets.	Offices for handling applications, interviewing applicants and adjusting employment problems.	40x25 ft.	$2,800.	Office furniture; files; toilets; waiting room benches; drinking fountains; heaters.
Field Engineers' Sub-Offices	Plain building, but with good windows and lighting. Office space.	Headquarters for field engineers. Surveying instruments and supplies.	40x20 ft.	$2,000.	Office furniture; instrument racks; lockers; heaters; shelves; benches.
First Aid Building	Emergency dressing and bedroom; office space; supply room; waiting room; toilet; ambulance exit.	First aid and emergency treatment for accidents. Should be located in center of work area.	30x22 ft. 8-ft. ceiling.	$2,400.	Doctor's office furniture; Examination room; emergency bedroom; medical supplies and instruments; heaters.
Testing Laboratory (Concrete, Earth, etc.)	Offices for concrete inspectors; curing room; special foundations for compression testing machines.	Testing of aggregates and concrete. Earth for earth dams, etc.	74x27 ft. 8 ft. 6 in. ceiling.	$4,300; 17c per cu.ft.	For Concrete: 150-ton compression testing machine; screens; 6-cu.ft. concrete mixer; storage bins; tanks; electric drier; work table; curing room humidity controls. For Earth Testing: Ovens; screens; centrifuge; scales and other special equipment; heaters. Offices for materials clerks and receiving clerks; issuing counter; shelves and bins; cable and rope racks; scales; desks; tables; heaters.
Warehouse	One-story storage building; 10-ft. loading platform along one side; large sliding doors; floor designed for approximately 275 lb. per sq. ft.	Storage for hardware, supplies, electrical equipment, finish lumber, new tools and miscellaneous small construction material.	250x40 ft. 10 ft. ceiling.	$10,000; 9c per cu. ft.	
Tool House	One-story, simple construction; "in" and "out" doors at issuing counters.	Issuing small tools, picks, shovels, boots, raincoats, etc.	48x20 ft.	$1,200	Issuing and receiving counters; checking board; tool racks; bins, etc.
Machine, Blacksmith, and Pipe Shop	Double doors and no floor but paved driveway through center; tool room at one end; master mechanic's office; welding bay.	Repairs to construction machinery, job fabricating, tool making, etc.	100x50 ft., with blacksmithy 50x 50 ft. 12 ft. ceiling.	$9,700; 8.6c per cu.ft. Equipment $13,000.	Machine Shop: 1- to 6-in. pipethreading machine; ⅜- to 2-in. bolt threading machine; 9x9-in. power hack saw; 6x6-in. power hack saw; 24-in shaper; 24-in. gap lathe; 20-in. lathe; 16-in. lathe; 3x6-in. radial drill press; 24-in. vertical sliding head drill; 16-in. pedestal grinder; 8-in. bench-type grinder; 12-in. pedestal grinder; Welding outfits; 500 cu.ft. compressor. Blacksmith Shop: 1 48-in. forge; two 36-in. forges; 3 anvils; 1 power punch; 600-lb. power hammer; quenching tanks.
Air Compressor House	Erect building after machinery is installed; heavy concrete foundations.	Furnish compressed air to all parts of job for drilling, grouting, cleaning concrete, etc.	40x75 ft.	$7,500; Equipment, $20,000 to $30,000.	Two 2,000 cu.ft. air compressors, one 1,000 cu.ft. compressor; motors and starting equipment; cooling tower. (Sizes depend on job)
Garage	Special doors; concrete floor; repair pit; overhead mono-rail tool room and office.	Repairing and servicing automobiles, trucks and tractors.	52x32 ft.	$3,800; 12.5c per cu.ft.	Work benches; battery charger; vulcanizer; hoists; tools; gas tanks; air compressor; greasing tools.
Carpenter Shop	Standard shop building; special large windows and lighting; large sliding doors; layout and erection platforms; separate office building free from noise.	All millwork on wood for special forms, etc. Prefabrication of forms, etc.	Shop 80x40 ft.; loading platform, 20x40 ft.; layout platform, 50x100 ft.	$5,300; Equipment, $2,700.	36-in. Band Saw; 24x8-in. single-cylinder surfacer; 20-in. planer and jointer; 18-in. swing saw; 14-in. saw table, tilting top.
Electricians' Shop	Work shop; supplies storage; office; loading platform.	Headquarters for electricians and electrical repairs.	52x24 ft.	$2,500	Motor rewinding equipment; storage bins; soldering and repair tools; wire racks.
Riggers' Shop	Standard shop with platform for cable reels, etc.	Headquarters for riggers.	52x24 ft.	$2,500	Cable splicing rack; cable-reels; block and tackle; bins for cable clips, etc.; office equipment.
Drill Sharpening Shop	3 sides and roof; no floor.	Sharpening drill steel.	34x50 ft.	$1,500; 4.6c per cu.ft.	Two steel sharpeners and bit punch; oil furnace and drill rest; fans; quenching tanks; steel storage; drill repair benches.
Reinforcing Steel Yard	Large storage area and office for foreman.	General storage area for reinforcing bars of all sizes and shapes. Bending facilities.	300 ft. square.		1½-in. bar size bar bender; 2-in. bar shears; hand bender.
Storage Yard	Large area of ground with locomotive crane or crawler crane service; railroad or truck unloading, etc.	Storage of large items of construction equipment; permanent materials; machinery; structural members; pipe, etc.	1 or 2 acres with small office for foreman.		Locomotive crane and track, or crawler crane; blocking; platforms, etc; pits; trestle; bins.
Docks and Railroad Sidings	Siding track and switches; unloading facilities; cribs; bumpers; capstans; harbor draft for towboats.	Receiving terminal for all shipments.	Space for 25 to 50 cars Barge tieup and anchor.		Warehouse; platform; crane or derrick; cement-handling equipment; hopper for barges under trestle.
Power Plant	Erect building after machinery; heavy concrete machinery foundation.	Generating electric power.	40x75 ft.	$7,500 and up	Diesel engines and generators; air compressor; oil separators; switchboard; electrical equipment.
Powder Magazine	Underground dugout or building with heavy walls and light roof.	Storage of explosives.			Safety locking devices; fences; separate building for detonators.
Oil and Gasoline Storage	One-story, simple construction; no floor.	Shed for storing oil and grease drums; gasoline depot.	40x20 ft.	$1,200	Racks for oil and grease drums; gasoline tanks; pumps.
Portable Shanties	Small shanties (on wheels).	Foreman and tools and material protection on job areas.	6x12 ft. and 10x20 ft.		Built-in table at one end; bench; shelves.
Pumphouse	Over well or water; on concrete or pile foundation; corrugated metal building.	Job water supply system, fire and service water.	20x30 ft.		12- or 14-in. pumps; intake; starter; motor; valves; piping.

CARPENTER SHOP and layout platform, in foreground, with chief carpenter's office separated from shop to escape noise. Platform is elevated to facilitate loading of trucks.

best possible accommodations for their men by spending from $100,000 to $300,000 of additional money on camps, but under competitive bidding this may be just the amount by which the job may be lost. The real responsibility rests with the agency for whom the project is being constructed. Just as the completed project will change the economic balance and population of the region, to which, incidentally, a great deal of planning is devoted, so the same agency should also assume responsibility for adequately planning for the emergencies which arise from suddenly imposing upon the region a new community during the period of construction.

It would seem quite feasible for such agencies to include in their designs and specifications for the main project suitable designs and specifications for dormitories, dining halls, cottages, houses and other community facilities so that all bidders could prepare their figures on the same basis. If such figures were filed as unit prices per building, the agency would be in a position to meet growing demands upon the community by ordering additional facilities constructed at the unit bid prices and retain a better position to combat the development of parasite communities with their attendant unsanitary and disease-promoting conditions, for which the occupants of such communities are least responsible.

Service Plant and Shops—The general service plant area, consisting of storage space, warehouses, shops, offices and other yards, deserves a great deal of study in determining the most effective layout. Where it is possible to centralize all buildings, much can be accomplished in coordinating the flow of materials, equipment and labor from the outside to the service plant into the construction job. Study of the layout of the Pickwick plant (see December issue, p. 33) indicates that the approach road over which materials and labor enter the job first passes through a parking area where laborers may leave their cars, then runs past the time office where the men check in, from which they enter the small tool shed and pick up their tools. From there they go to the garage, machine shop or electrician's shop and on to the work. Materials coming in are readily delivered to one of the shops or directly to the warehouse. The compressor building is located as central to the work area as possible, convenient both to shops and construction area, and the office and testing laboratory is located at some distance from the compressor plant and other noisy operations, but still convenient to all operations. Most of the lumber will arrive by water at a ferry landing, from where it will be handled by derrick to unloading docks into a lumber yard and from the lumber yard into the carpenter shop, from where built-up forms are delivered to the construction area. Here again the straight line sequence of operations is evidenced.

LUMBER YARD at Wheeler dam, showing assembly platform, in background, with large draft tube forms under construction and section of completed draft tube forms stored along track, on which locomotive crane operates.

Additional smaller buildings of the portable type are needed around a large job for headquarters of assistant superintendents and engineering layout crews.

The general requirements of service plant facilities and buildings, together with equipment, are presented in the table herewith. As a rule buildings are of simple construction, consisting of wood frames, corrugated siding and roofing, except such buildings as the office, tool house, and electrician's shop, etc., where wood sheathing on the walls is desirable or convenient for attaching shelves and other facilities. Typical construction consists of timber mud sills, 8 x 8-in. posts, 2 x 8-in. joists, 2 x 8-in. flooring, 1 x 12-in. vertical siding with 1 x 3-in. stripping, or corrugated iron, 2 x 6-in. rafters, 2 ft. on centers, 1 x 8-in. sheathing and metal or 3-ply slate roofing.

Reinforcing Yard—The layout of a reinforcing yard and system of handling steel deserves special consideration. In some cases builders prefer to have all reinforcing steel cut to length and bent by the fabricator, in which case it is necessary to provide a very large storage area for the hundreds of different types or shapes of bars which go into a large structure. This system may have advantages where ample storage space is available and where design details are known sufficiently in advance to permit ordering the reinforcing steel well ahead of actual needs. However, more generally, this is not the case and a very satisfactory system of operation consists of buying various sizes of steel in stock lengths. By properly studying the supply and general requirements the steel may be cut and bent on the job without incurring a great deal of waste. In fact, it is sometimes surprising how small a waste pile finally develops under this system. A yard organized on this basis requires a heavy shear and bending machine which can handle bars at least up to 1¼ in. in size. Such equipment is almost essential with any system of handling reinforcing steel because generally changes occur on the job and new design requirements make it necessary to fabricate and bend a certain amount of special steel almost daily.

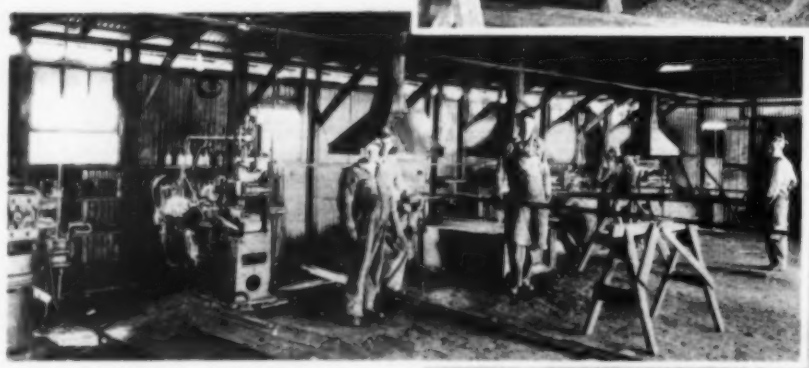
Utilities for Service Plant Areas and

SHOP AREA at Pickwick Landing showing, left to right, machine and blacksmith shop, garage repair shop, small tool building, time-keepers office and checking windows, lunch counter and first-aid station.

Shops—Most of the modern construction projects are operated entirely on electric power and the location and layout of transmission lines, substations, distribution feeders and transformers, is a major item of planning. The most difficult point to determine is the maximum peak requirements of power. An interesting experience occurred at Norris Dam, a project requiring the placing of about 1,000,000 cu. yd. of concrete. The total connected load at Norris Dam is 6,500 kva., which had an annual consumption of 15,738,000 kw.-hr. during 1935. The maximum peak load was 3,100 kva. supplied from a substation with a capacity of 3,500 kva. This margin was so close that when it became necessary to operate the electric heat treatment on the welded penstocks it was necessary to stagger the work so that the heating system could be operated when the rest of the plant was shut down for maintenance work. The connected load at the town of Norris is 9,500 kva. This large load is chiefly due to the electric heating system of the entire community. The annual load factor at Norris Dam was 75.5 per cent against a load factor of 45.3 for the town of Norris.

Water Supply—The problem of meeting the maximum demand for water is equally important. Two supplies are generally required. One, for fresh water to serve the camp for drinking and miscellaneous domestic purposes, can also be piped to advantage around the work area to provide an ample supply of drinking water to the workmen, which is further supplemented by water carried on the job. The raw water supply is used for mixing concrete, washing aggregates, curing concrete, cleaning up for new pours, and all of these items demand a large amount of water. For a job running into about 1,000,000 cu. yd. of concrete, a raw water storage tank with a capacity of 100,000 gal. is not too small. At Grand Coulee storage is provided for 350,000 gal., which is delivered to the job at a pressure of 60 to 110 lb. per square inch.

Air Supply—Compressed air is considered an indispensable construction tool and deserves considerable study in planning a service plant layout. As a rule, a large compressor station is set up at a strategic point in the job area and from here supply lines radiate in all directions to feed air to the jackhammers, wagon drills and other rock drilling tools. Air is also used extensively in combination with water for cleaning off concrete surfaces prior to placing new concrete on them, and for the operation of cement pumps, gates on gravel bins, various types of air-driven tools and small sump pumps. The equipment in a representative compressor station on large jobs generally consists of units ranging from 1,000 to 3,000 cu. ft. per minute capacity in stationary units. The accompanying table gives representative capacities which have been installed on large projects:



DRILL SHARPENING SHOP for large job, showing sharpeners and oil-burning furnaces. Front of shop open to facilitate handling steel.

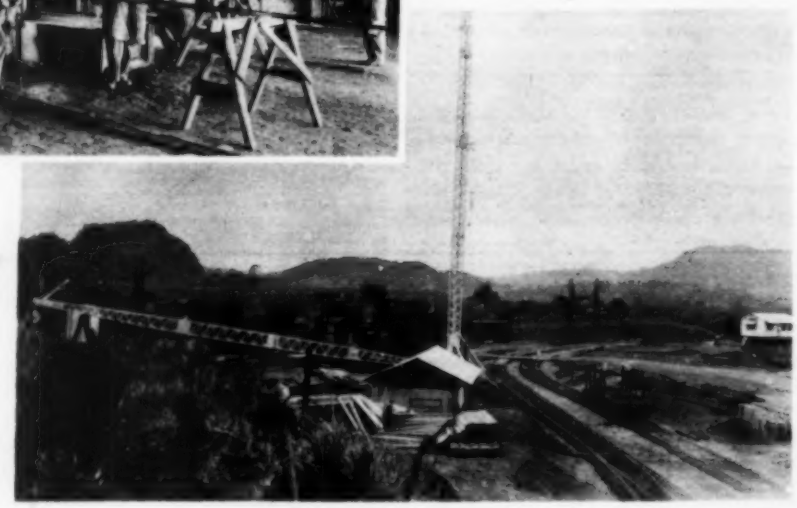
AIR COMPRESSOR CAPACITIES ON LARGE PROJECTS

DAM	Stationary Compressors cu. ft. per min.	Portable Compressors cu. ft. per min.
Norris	7140	620
Wheeler	7516	247
Conowingo	3400	2700
Santeetlah Dam	2500	
Santeetlah Project (stationary compressors for the entire project including tunnels	10,240)	
Calderwood	6,000	
Waterville	4,000	

in stationary and portable compressors

The most important principles to observe in laying out an air supply system is the cost of foundations and distribution system and friction losses in pipe lines when using a central compressor plant with stationary compressors, as compared with the maneuverability of smaller units of the portable type. Where a job is spread out over a large area portable compressors have many advantages and will prove quite satisfactory, particularly if connected to a receiver for equalizing the intermittent consumption when operating jackhammers, wagon drills and similiar pneumatic tools.

BAR-BENDING MACHINE installed adjacent to reinforcing steel storage yard.



RAILWAY SIDING YARD is equipped with guy derrick for handling heavy equipment.

Job Lighting—There are a variety of ways in which satisfactory job lighting can be provided. At the start of a job it may be necessary to have portable lighting plants on the ground until the regular power supply is available. Considerable opportunity exists for improving the systems of job lighting by erecting high poles with floodlights similar to the ones used for night baseball or football so as to keep as many as possible of the lighting circuits and lamps off the work where they would be continually subject to damage. A very satisfactory system of lighting can be supplied on jobs equipped with cableways by stringing overhead systems from tower with about 1,000 watt lamps spaced at 200-ft. centers.

Employee Transportation—On certain jobs, such as Boulder and Norris dams, the community was located at some distance from the work and it was necessary to furnish special transportation facilities. As a rule, such facilities must be available at all times and the proper staggering of heavy-duty transport units with smaller units during off-peak hours offers opportunity for economy.

Heavy Equipment Handling—At the railroad terminal and at the storage area near the work it is usually necessary to provide a crane, derrick or other facilities for handling heavy equipment. The best system usually depends upon a careful study of local conditions.

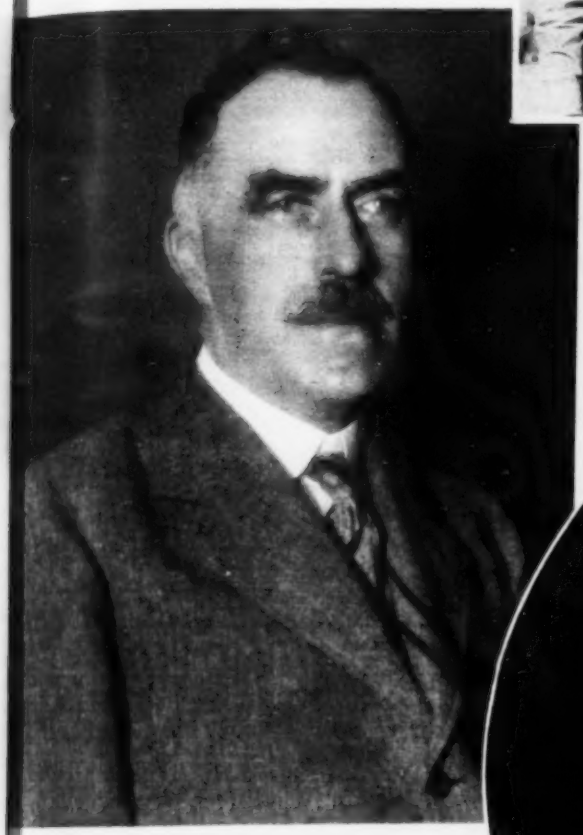
ADEQUATE LIGHTING insures progress of night work at Grand Coulee dam. Improved floodlights with special reflectors have been designed especially for construction operations.

★

NEXT MONTH—Chapter 4 of the series on "Heavy Construction" by A. J. Ackerman and Charles H. Locher, to appear in the March issue, will deal with "Construction Layout, Schedules, Equipment Selection and Control."

Present and Accounted For —

A Page of PERSONALITIES



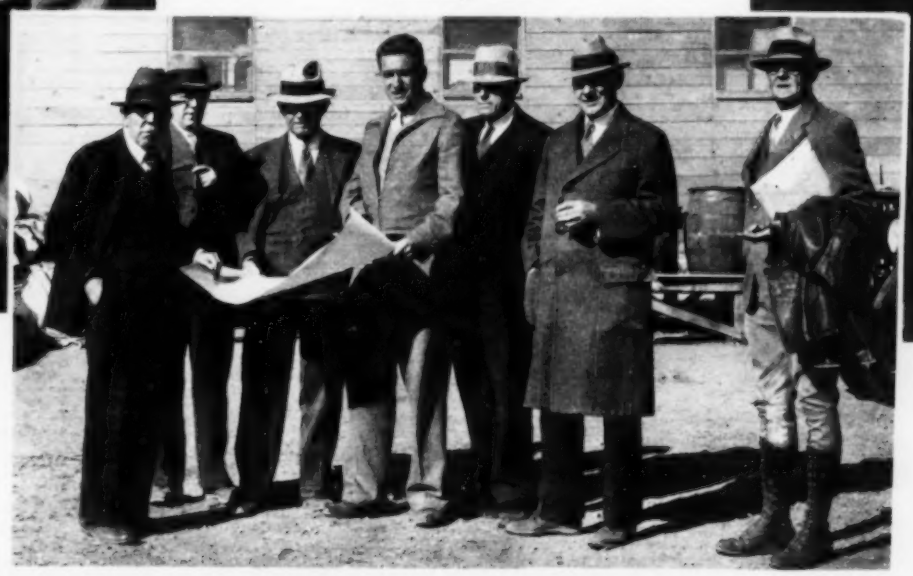
STATE PLANNING IN MASSACHUSETTS now claims abilities of Arthur W. Dean *(below)*, recently appointed chief engineer of State Planning Board, following many years service as chief engineer of Massachusetts Department of Public Works.

CAJALCO DAM BUILDERS. (Left to right) Rex B. Sawyer, general superintendent, S. M. Griffith, president, and D. H. Moore, vice-president, of Griffith Co., Los Angeles, direct work on $4,650,000 earth dam and dike contract at western terminus of main Colorado River aqueduct for Metropolitan Water District of Southern California.

1936 LEADER of American Association of State Highway Officials is Gibb Gilchrist *(below)*, state highway engineer of Texas, elected president of association at recent convention in Miami, Fla.

PROMOTER OF GREATER SAFETY in construction. Welton A. Snow, safety director of Associated General Contractors, serves also as chairman of executive committee in construction section of National Safety Council.

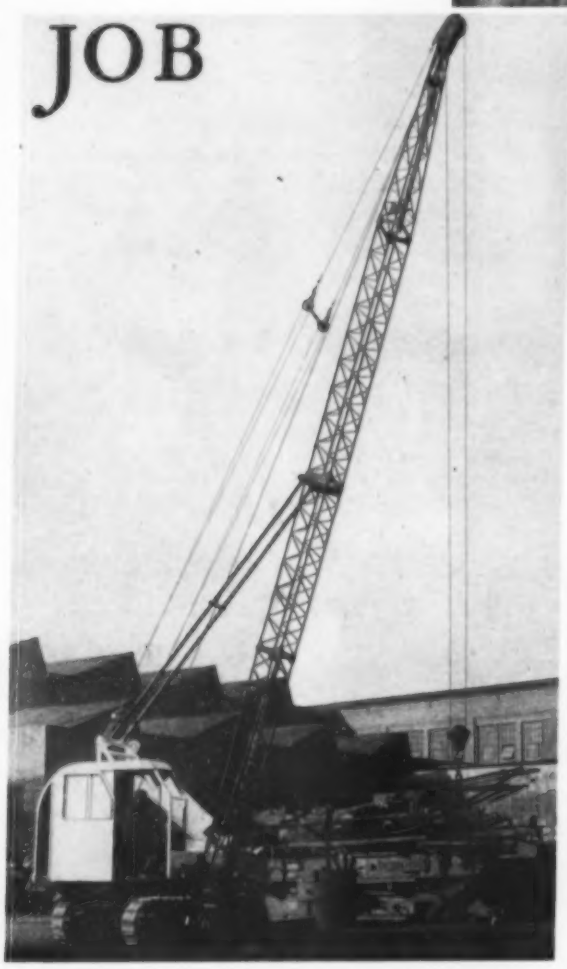
CONCHAS DAM INVESTIGATION preceding final design of flood-control, water-supply and irrigation project on South Canadian River in New Mexico is carried out under direction of District Consulting Board: (left to right *below*) William Gerig, head engineer, Office of Chief of Engineers, Washington, D. C.; Joel D. Justin and Louis C. Hill, consulting engineers; Capt. Hans Kramer, district engineer, Tucumcari, N. M.; Harry T. Cory, consulting engineer; W. H. McAlpine, head engineer, Office of Chief of Engineers; and Gerald H. Matthes, principal engineer, Office of Division Engineer, Vicksburg, Miss.



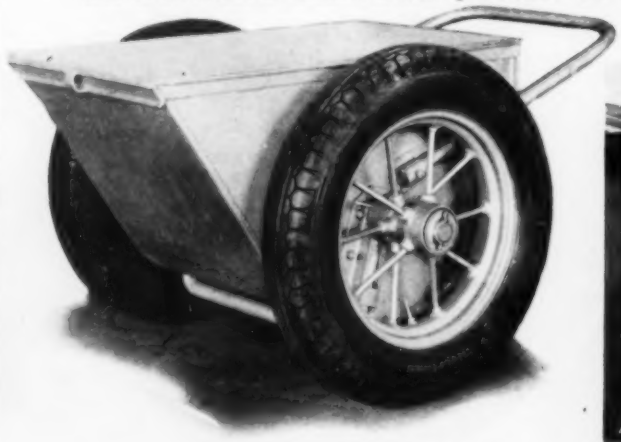
OKLAHOMA HIGHWAYS are present responsibility of Van T. Moon, state highway engineer, who directs design, construction and maintenance for Oklahoma Highway Commission.

New Equipment on the Job

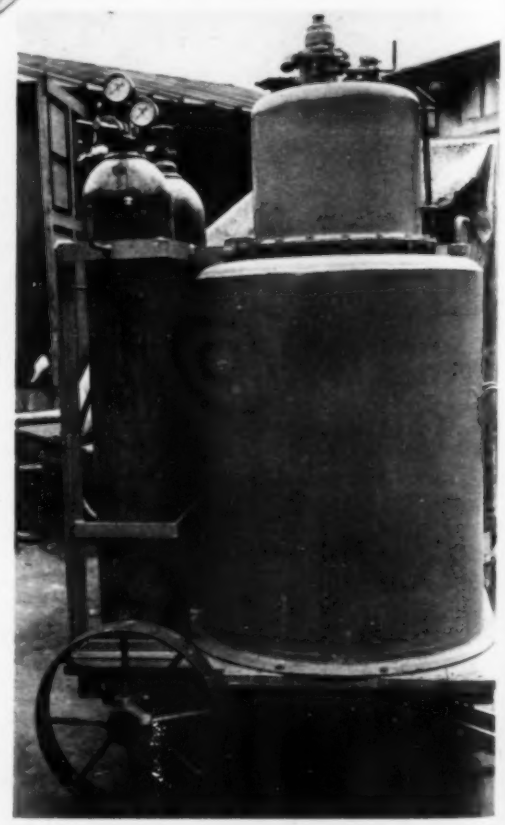
30-YD. WATER-LEVEL CAPACITY provided by "Cradledump Buggy", new earth-moving carrier built for use with large-size tractors and, without front axle, for use with trucks as a semi-trailer. Inside body dimensions are 9x13 ft.—large enough to make unnecessary careful spotting of shovel buckets when loading. Unloading controlled from tractor driver's seat by ½-in. steel cables and sheaves connected to standard 2-drum power-control unit mounted at rear of tractor motor. Body, pivoted at top, expels its load by moving in cradle-like arc to side, forcing entire load off buggy as it moves. Unit constructed of special alloy steel, electrically arc-welded, with double bottom. Both "Cradledump Buggy" and Hug tractor truck developed for use with it are mounted on 18x24-in. tires, providing ground contact of 6,000 sq.in.—R. G LeTourneau, Inc., Peoria, Ill., and Stockton, Calif.



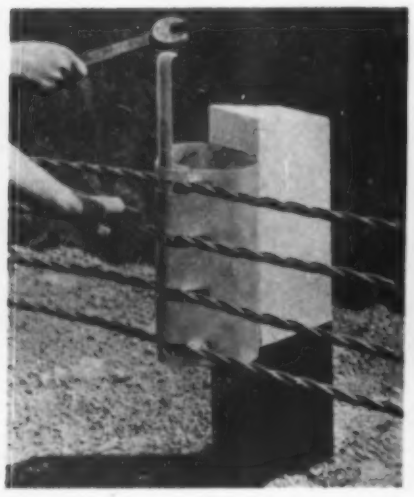
ALL-WELDED 50-FT. BOOM, twice standard length, is mounted on "Bantam-Weight" 15,000-lb. crawler crane for use of Standard Oil Co. of California at refinery at Bahrein Islands between Persia and Arabia. Boom is made of standard pipe with two inserts welded to ordinary 25-ft. unit. Rated lifting capacity of machine is 1,800 lb. at 20-ft. radius, but tests show ability to handle 2,150 lb. with reasonable speed and ample stability. Additional equipment includes high gantry and telescopic boom stops.—Harnischfeger Corp., Milwaukee, Wis.

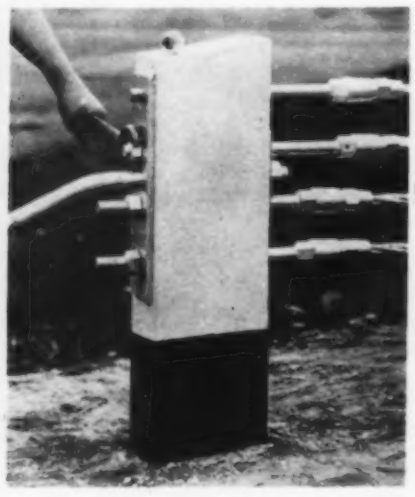


CONCRETE AND MATERIAL CARTS of balanced, all-welded steel construction and in two new sizes are offered to contractors interested in efficient handling of bulk cement and concrete. Two of the 9-cu. ft. units are suited for handling batch from 14-S mixer, and 11-cu.ft. model will take regular batch from 10-S mixer, thus saving time spent in dividing load. Both sizes offered either with balloon pneumatic-tired roller bearing wheels or with regular steel-tired wheels. Rubber-tired wheels are of drop center rim type using standard 18x5.25-in. tires, insuring low first and replacement costs. Tread on 11-ft. unit, 37 in. — Construction Machinery Co., 403 Vinton St. Waterloo, Iowa.



SMALL-SIZE, MEDIUM PRESSURE acetylene generator, for portable and stationary service with any type of oxy-acetylene cutting or welding apparatus, has 50-lb. carbide capacity with double rating of 100 cu.ft. of acetylene per hour. Handwheel at generator top makes it possible to control carbide feed for any desired acetylene pressure up to 14 lb. per square inch. Gravity-type, pressure-diaphragm carbide feed control, carbide hopper, hydraulic back-pressure valve and filter all assembled within dome-shaped top of generator which may be tilted back when inspection is necessary. May be mounted on truck or fitted for permanent installation to supply medium-pressure acetylene through pipe lines.—Linde Air Products Co., 205 E. 42nd St., New York City.

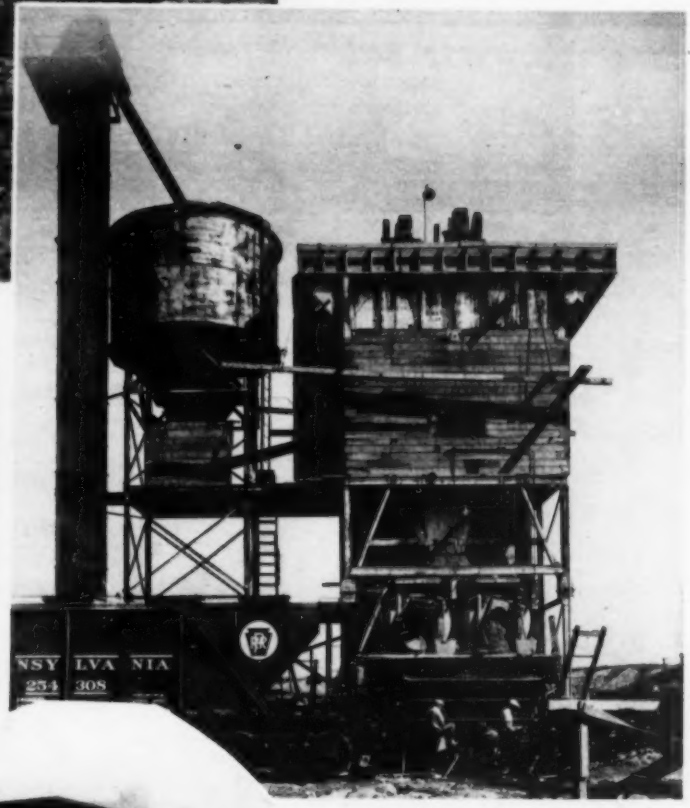




ADDITIONAL SAFETY FOR MOTORISTS *(left)* is provided by cable highway guard consisting of steel offset brackets securely bolted to posts and slotted in front to receive wire cables which are held in place by stay pins. Resilient post bracket is so designed as to deflect readily any part of colliding car and prevent entanglement with bumpers, hubs or fenders. Slots permit free longitudinal movement of cables in either direction, allowing characteristic slackness of cable to aid in cushioning blow of collision. Tightening or loosening of cables is accomplished by adjusting take-up bolts at end posts. By use of bracket, three to nine cables may be used.—American Steel & Wire Co., 208 S. La Salle St., Chicago, Ill.

SMALL TRACTOR GRADER *(left)* for road construction, ditching and maintenance work in townships and smaller cities, is claimed to be only machine below 5,000-lb. class that is not horsedrawn. Equipped with 8-ft. blade; weight, 3,575 lb. Embodies all design features offered in larger models, including welded box-frame construction, adjustable tractor pole, leaning wheels and extensible lift link for extreme blade positions. Built to match tractors between 20 and 35 hp.—Caterpillar Tractor Co., Peoria, Ill.

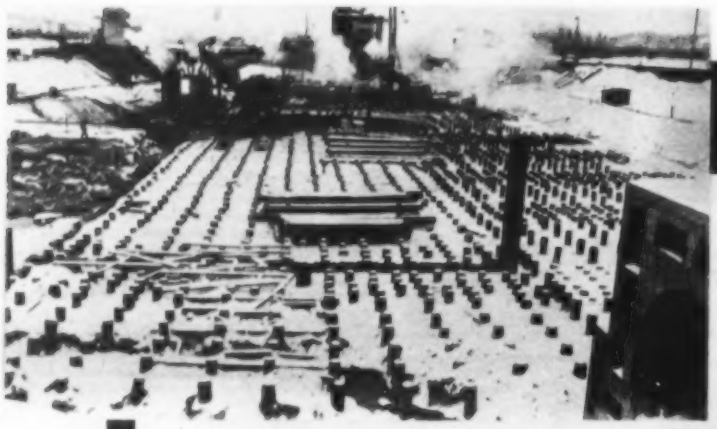
ROAD MAINTAINER *(above)* is multi-purpose unit equipped for upkeep of highways and for general hauling. Has 148-in. wheel base, heat-treated frame, 2½-yd. dump body and hydraulically-operated 10-ft. spring scraper. Six forward and two reverse speeds or three maintaining and three hauling road speeds are provided by sliding gear type transmission. Powered by 85-hp. motor. Can be used for grading with underbody blade; as power unit to haul trailers, ditch graders, mowing machines and other specialized equipment, for pushing a snow plow and to haul loads of snow fence or gravel and construction equipment. Safety and dependability provided by added traction of four driving wheels, booster-operated hydraulic brakes and 9.75x20-in. dual tires. Stream-lined fenders, hood and cab.—Four Wheel Drive Auto Co., Clintonville, Wis.



PORTABLE CRUSHING PLANT reducing large stone to ¾-in. aggregate in one reduction at rate of 300 tons per day.—American Pulverizer Co., 1245 Macklind Ave., St. Louis, Mo.

DISCHARGE TIME DECREASED substantially by improved design of heavy-duty concrete mixers in three capacities of 1, 2 or 3 cu.yd. for large volume jobs. Large diameter mixing drum of 28-S mixer illustrated above is speedily charged through 30-in. drum opening. Ten pickup buckets with five throwover blades thoroughly mix batch. High side of wide tilted power-operated discharge chute extends far into drum just below full width of buckets. In one revolution of drum, each bucket practically transfers entire load without spilling to discharge chute where it follows natural flow line of travel without long drops or sharp breaks. Mix texture is not disturbed and abrasive wear reduced to minimum. Power unit is mounted directly behind drum and countershafts and cumbersome gear arrangements are eliminated, shortening frame and permitting installation in minimum of space. May be mounted in batteries of two or more without mechanical changes. Powered by 20-, 40- and 60-hp. electric motors or by gasoline engines.—Koehring Co., 3026 W. Concordia Ave., Milwaukee, Wis.

UTILITY JACK, suitable for stretching, pulling, binding or lifting, consists of frame with operating parts, 10-ft. stretcher chain and 5-ft. anchor chain. Will handle loads up to 4,000 lb. When in use, stretcher chain fits over teeth in sprocket wheel and power is supplied by raising and lowering handle. Axle of handle, being eccentric, transmits power through two pawls engaged in wheel. As one pawl is always in position, wheel cannot slip. Weight, without chains, 34 lb.—American Chain Co., Bridgeport, Conn.



"If Winter Comes"

Before the snow came Moretrench had pushed twenty-two feet of water overside. For good measure it threw out five feet more below the bottom. That gave the contractor a cleaned up sub-grade:

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STRONG enough to skid pile drivers on—*without framed supports.*

DRY enough to make the rubber boot business dull, and

SAFE enough to be blow-out proof.

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LORAIN • 77 • 75D • 55D—Diesel powered to increase output 10-20%, cut fuel costs 50-80%.

LORAIN • 40 • 37 • 30 • 27—Capacity by Stability and Strength, not Weight. The L-40 gives 3/4 yd. capacity at practically 1/2 yd. weight.

TRUCK SHOVELS AND CRANES—Greater Capacities combined with high speed motor truck mobility.

Each of the Lorains, from 2 yd. to 3/8 yd., is built to Thew's famed, tested and proved Center Drive design of simplicity, ruggedness and power efficiency. From these select the Lorain to suit your job—it will move more dirt, faster and cheaper. Bulletins available, write today.

THE THEW SHOVEL CO., LORAIN, OHIO

LORAIN-87
LORAIN • 95
• LORAIN • 77-75D-55D
• LORAIN • 40-37-30-27 • Universal • Lorains
Big Capacity, Long Range Dragline • 1 1/2—1 1/4—1 yd. Diesels • 3/4—5/8—1/2—3/8 yard • Truck Shovels and Cranes

Powered with a Ford V-8 motor for low operating and upkeep costs. The whole motor can be replaced for only $47.50.

THAT'S what counts in a small-job business. If you're setting out on a 20,000-yard dirt-moving job, you may take it a little easy. But when you're going after basement jobs, you've got to get on the job quick and be through with it fast . . . or else! The Bantam-Weight's built for the man who's in a hurry. • Here's a typical job—away from the yard at 7:00 A. M., three miles to the job, excavating 165-yard basement, out of the hole and away again by 12:30 P. M. • How does the Bantam-Weight get such speeds? Because every ounce of excess weight has been stripped off . . . because we've used the newest high-tensile alloys . . . because it's powered with a peppy Ford V-8 motor . . . because it's the most up-to-date machine on cats. If you'd rather compete with speed than against it, find out now about the Bantam-Weight.

HARNISCHFEGER CORPORATION

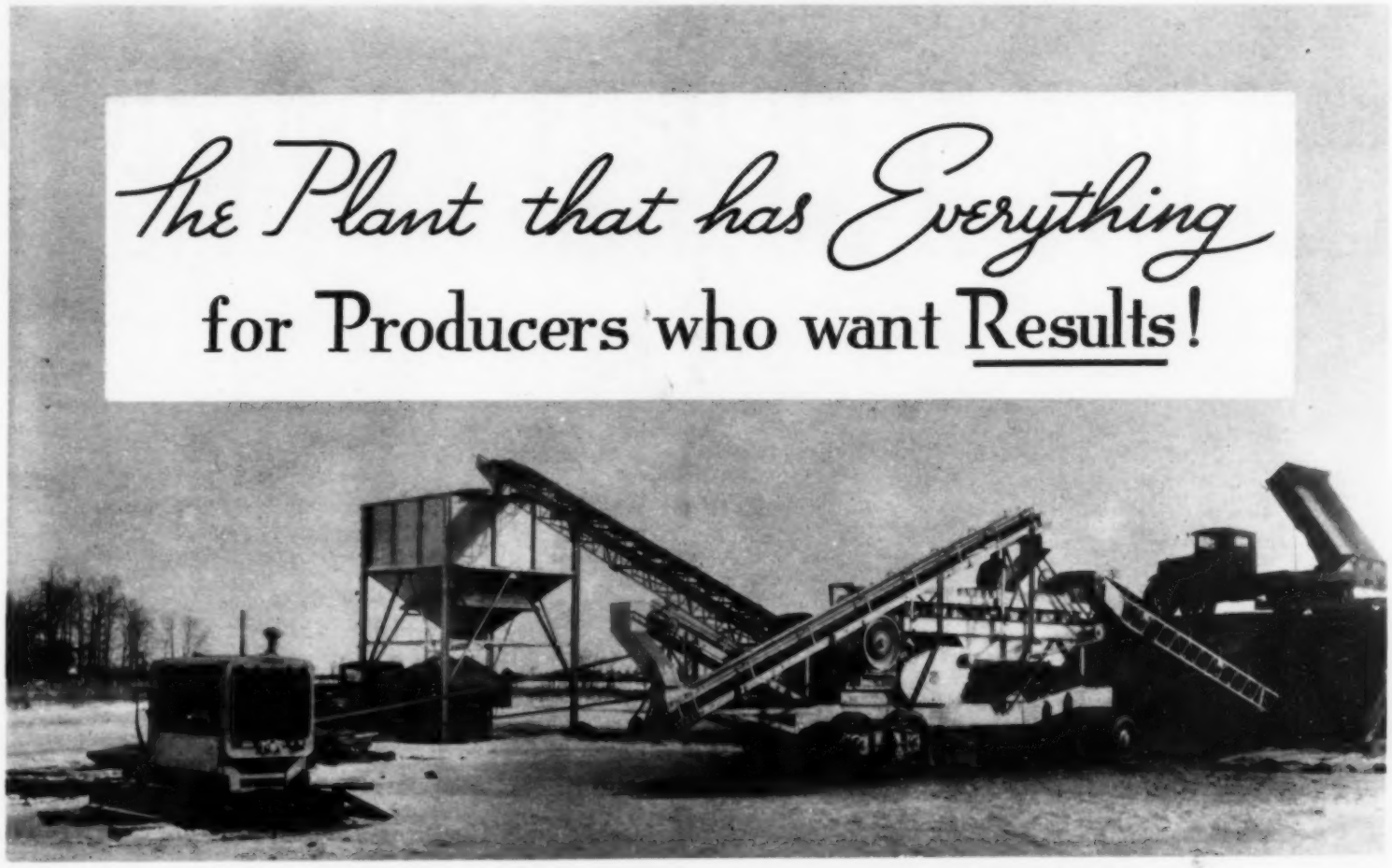
4494 W. NATIONAL AVE. *Established 1884* MILWAUKEE, WIS.

Warehouses and Service Stations: Hoboken—Memphis—Jacksonville—Seattle—Dallas—Los Angeles—San Francisco

P&H BANTAM WEIGHT

FIRST TO THE JOB — AND FIRST THRU

ONE OF THE 22 P&H PACEMAKERS FOR 1936



Iowa Super-Straight Line Portable Plant
Complete With Diesel Power

1936 ushers in a new type of portable crushing and screening plant—it's the new IOWA SUPER-STRAIGHT LINE SERIES. This large capacity portable plant combines the utmost of capacity with portability and long life. Nowhere can you buy a plant that will give you lower unit costs for your aggregate production—nowhere can you find a plant with so many outstanding advantages as are built into this SUPER-STRAIGHT LINE Plant—made by IOWA.

MAIN UNITS OF THE SUPER-STRAIGHT LINE

(1) Iowa roller bearing crushers—SKE equipped. Larger capacities—grease only twice a year.

(2) Roller Bearing Roll Crushers—4 sizes available for the secondary crushing.

(3) IOWA-SYMONS VIBRATOR SCREEN—the most efficient screen on the market.

(4) Roller bearing throughout the entire plant—Large 24" or 30" conveyors—variable stroke feeders.

(5) Axle equalizer on rear wheels—solid or pneumatic tires.

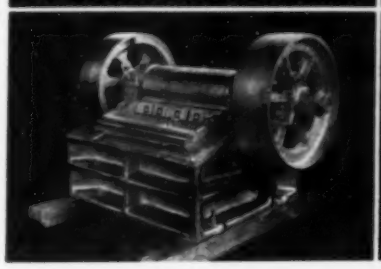
(6) Swivel Feed Conveyor—Large hopper capacity—easy to change saws and roll shells—and—dozens of other exclusive features.

IOWA MANUFACTURING COMPANY

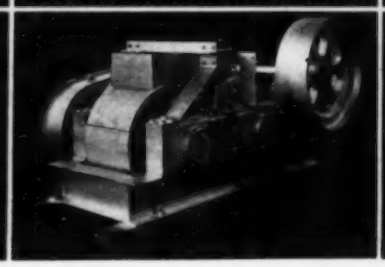
CEDAR RAPIDS, IOWA

ASK FOR THE SUPER-STRAIGHT LINE BULLETIN

SKF ROLLER BEARING CRUSHER

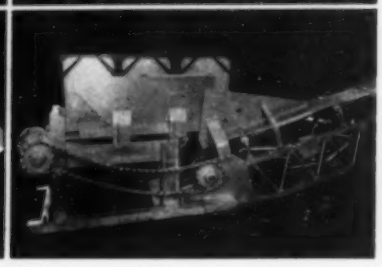


ROLLER BEARING ROLL CRUSHER



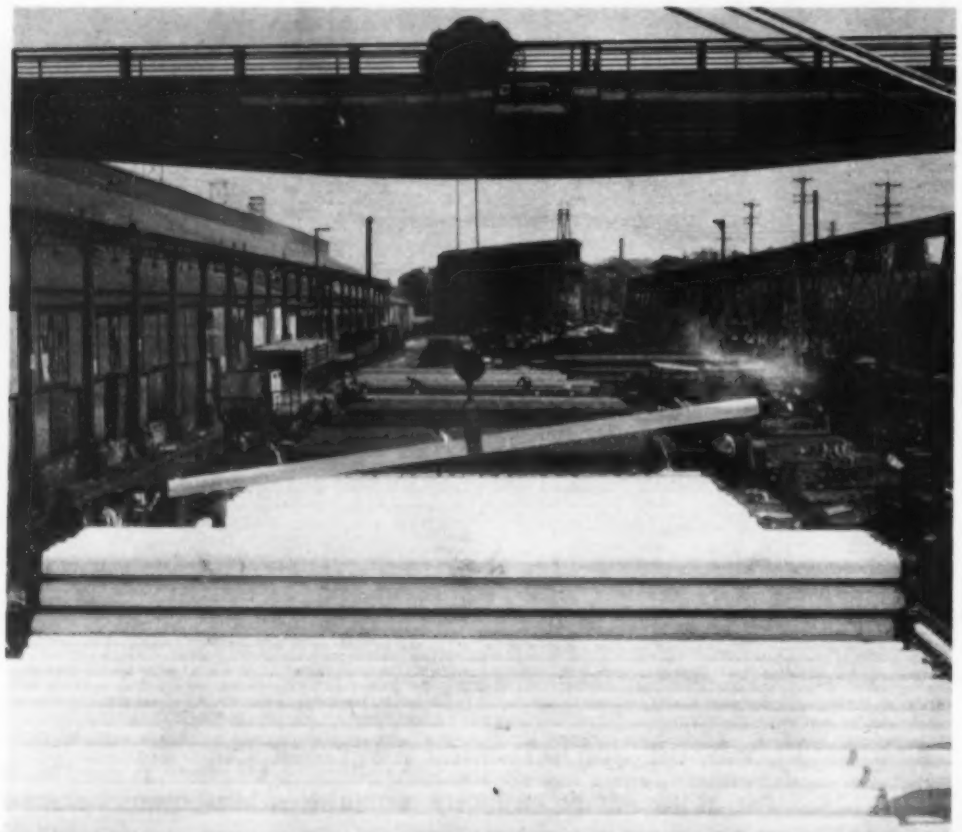
IOWA-SYMONS VIBRATOR SCREEN

FEEDER FOR SWIVEL CONVEYOR



Here's Pipe That

CAN GIVE IT AS WELL AS TAKE IT



Above: Ready for shipment... Armco Spiral Welded Pipe after helical welding by automatic precision machines.

Below: A tough layout, this, but not for Armco Spiral Welded Pipe. The ductility and flexibility of this strong, easy-handling pipe makes for easy going over any kind of terrain.

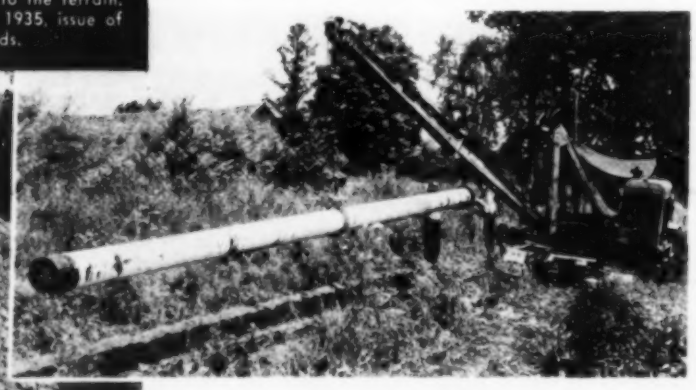
Right: In Palmyra, New York, Armco Spiral Welded Pipe cut costs through easier handling and ready adaptability to the terrain. See the November, 1935, issue of Construction Methods.

THERE has been a lot of talk about pipe that can take it. Now let's talk about *giving it* as well as taking it, because ARMCO Spiral Welded Pipe "goes to town" on both scores.

Here are some of the advantages it gives . . . Peak flow capacity induced by smooth inner walls . . . great strength combined with exceptional ductility . . . economical permanence based on generous performance before replacement . . . utmost service and safety per dollar of cost.

And that's not all: ARMCO Spiral Welded Pipe, as sturdy and serviceable as it is, is relatively light and trim. Long, accurate lengths that go together tightly mean low leakage loss. Service interruptions are mighty few.

The sizes are 6-inch to 36-inch. Wall thicknesses run from 12-gage to ½ inch, lengths up to 40 feet. You can use any common joint, and specify the pipe in durable ARMCO Ingot Iron or Steel. Any regular or special fittings can be provided, and the coatings are optional.



★

USE
ARMCO SPIRAL WELDED
FOR

Heavy-wall permanent jobs
Light-wall temporary jobs
Dredge pipe installations (special analyses steel walls)
Air-pipe installations
Special industrial piping

★

Invest your pipe dollars in ARMCO Spiral Welded and bid good-bye to installation and service troubles. Shall we send you complete information? The American Rolling Mill Company, Pipe Sales Division, Middletown, Ohio.

ARMCO SPIRAL WELDED PIPE

Forked River Yacht Basin

improved with BETHLEHEM Steel Sheet PILING

AN interesting example of the use of Bethlehem Steel Sheet Piling is afforded by recently completed improvements authorized by the State Board of Commerce and Navigation in the yacht basin at Forked River, N. J.

Around a portion of this basin a bulkhead of Bethlehem Piling, supplemented by a wooden fender system, has been installed, adding decidedly to the attractiveness and utility of the shore line. Part of the land reclaimed is now occupied by service facilities. To accomplish these objectives required the use of only 59 tons of steel sheet piling.

Reasons for the use of Bethlehem Steel Sheet Piling in this bulkhead at Forked River are the same as those which have led to its use in so many other projects: great strength, long life, low cost of installation, low expense for maintenance. Bethlehem Steel Sheet Piling is the strongest material available for the building of earth-retaining structures. It forms a wall with strong, sand-tight interlocks between the individual pieces. It is readily driven or jetted to depths that can be obtained with other materials only with difficulty and added cost. And it lasts for years, even in salt water.

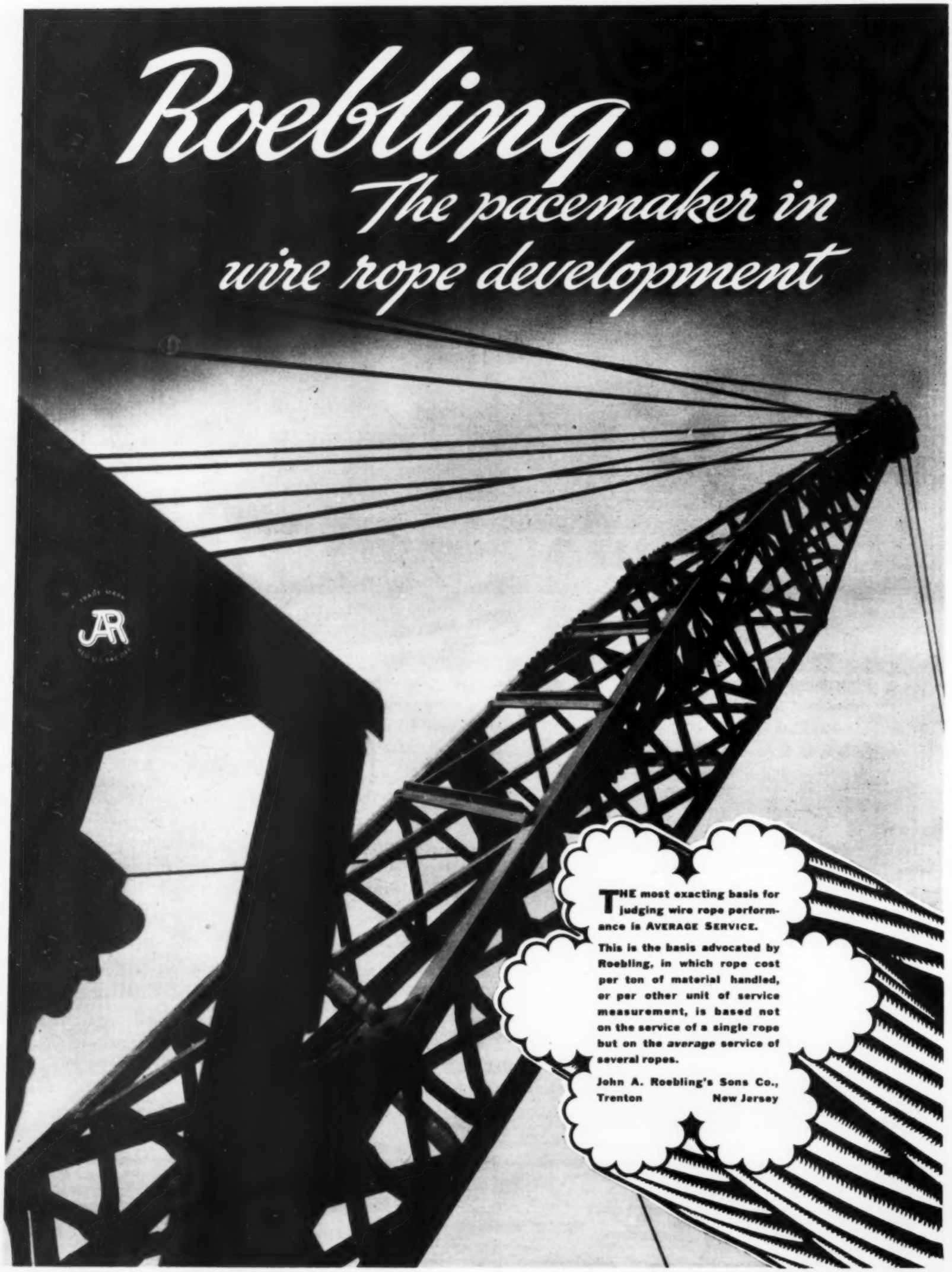
Gray Construction Company, Morristown, N. J., Engineers and Contractors

The bulkhead of Bethlehem Steel Sheet Piling adds materially to the attractiveness of the shore line

BETHLEHEM STEEL COMPANY
GENERAL OFFICES: BETHLEHEM, PA.

Roebling...

The pacemaker in wire rope development



THE most exacting basis for judging wire rope performance is AVERAGE SERVICE.

This is the basis advocated by Roebling, in which rope cost per ton of material handled, or per other unit of service measurement, is based not on the service of a single rope but on the *average* service of several ropes.

John A. Roebling's Sons Co., Trenton New Jersey

Superintendent: If you don't believe this "62" digs more dirt, get up there and try it.
Contractor: I don't have to try it. Our cost sheet proves it's a money maker. . . .

FASTER OPERATION AND FLEXIBILITY OF MOVEMENT MAKE THE BYERS MODEL "62" A MONEY MAKER

Of course, the Model "62" digs more dirt—and digs it more economically. Engineered with 32 Timken tapered roller bearings, the crowd-propel clutches ...swing clutches...and all deck shafts operate practically friction free. This roller bearing construction cuts swinging and digging time 10 to 15%. Direct power drive—two speed travel that operates independently of the swing or while swinging—all these and other features increases job profit. • Contractors who haven't been in a shovel cab for years get a real thrill trying their hand on a "62." The effortless ease of handling due to roller bearings as applied by Byers engineers suprises them. The new practical cab excites their admiration—they see its advantages. If you haven't tried a "62" do so at the first opportunity. Write and we'll tell you where you can try one.

BYERS

BYERS
MACHINE CO.
RAVENNA, OHIO

announcing
Greater 1936 values in General Motors Trucks

1. Cost-reducing improvements throughout the entire line.
2. Advanced streamline appearance.
3. For the first time, money-saving GMC dual performance axles in 1½ ton to 6 ton capacity ranges.
4. More distinctive, more comfortable streamlined cabs.
5. Correctly sized engines for maximum economy and improved performance—in every capacity range.
6. A new quality low-priced ½ ton delivery.
7. A greater value in the 1½-2 ton range. At this extremely low price you can now get the quality GMC many-feature truck that is built to out-perform and out-earn. $525

½ TON $425 TRUCKS OF VALUE

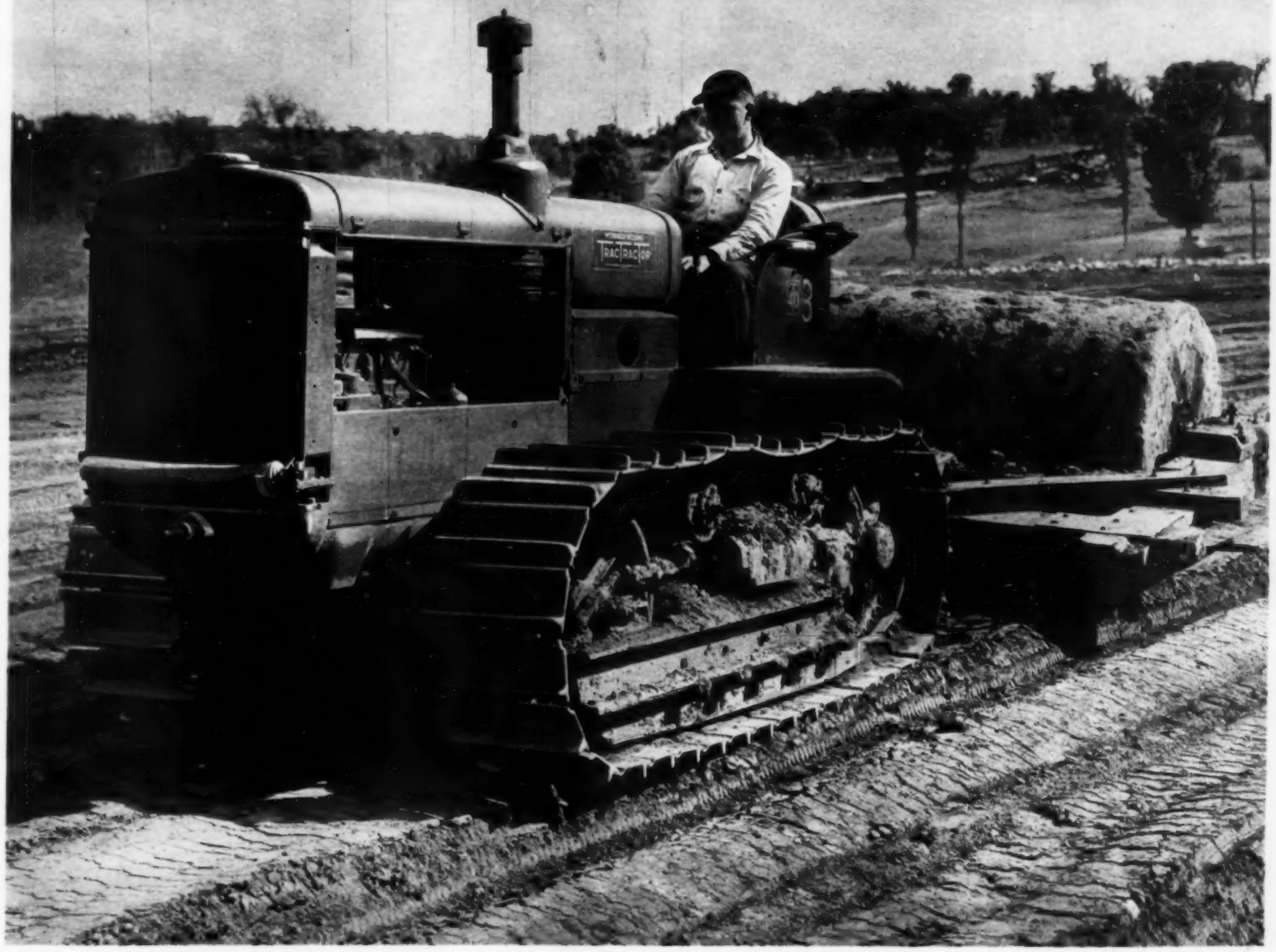
Time payments available through our own 6% Y. M. A. C. plan

General Motors Trucks and Trailers

GENERAL MOTORS TRUCK COMPANY · PONTIAC, MICHIGAN

½ TO 15 TONS

A Wealth of Experience Back of
INTERNATIONAL HARVESTER POWER



An International Harvester T-40 TracTracTor pulling an 8-ton concrete roller on top of the East Barre rolled-earth dam near Waterbury, Vt. This is one of the new flood-control dams being built across the Winooski river. Four TracTracTors were used on this dam.

●

The International Harvester line of industrial power (gasoline and Diesel) includes TracTracTors, wheel-type tractors, stationary power units from 12 h. p. to 100 h. p., and 1½ to 5 h. p. engines for light-duty service.

INTERNATIONAL HARVESTER Industrial Power—product of the world's largest tractor builder—reflects the valuable experience this organization has gained through its long and close association with you engineers, contractors, road builders, public officials, and other users of heavy-duty power.

Take the TracTracTor for example. In designing this tractor, International Harvester put onto the market the *most accessible, most easily serviced* crawler. Steering clutches and brakes can be inspected, adjusted, or replaced through rear cover plates without disturbing the tracks, track frames, or driving sprockets. And working parts are thoroughly protected against entrance of abrasive materials by the effective use of self-adjusting triple dust seals.

Your best investment in industrial power is International Harvester. The nearest industrial dealer or company-owned branch is ready to serve you well.

See them about a demonstration.

INTERNATIONAL HARVESTER COMPANY
606 So. Michigan Ave. (Incorporated) Chicago, Illinois

INTERNATIONAL HARVESTER

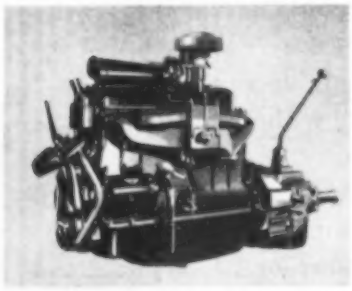
CHEVROLET *announces*

A GENERAL MOTORS VALUE

the most powerful and the most economical Chevrolet trucks ever offered to the

BUILDING AND CONSTRUCTION INDUSTRIES

NEW PERFECTED HYDRAULIC BRAKES always equalized for quick, unswerving, "straight line" stops.



NEW HIGH-COMPRESSION VALVE-IN-HEAD ENGINE with increased power, increased torque, greater economy in gas and oil.

FULL-FLOATING REAR AXLE with barrel type wheel bearings on 1½-ton models.

CHEVROLET Chevrolet introduces a new 1936 series of half-ton and 1½-ton trucks. They are the most powerful Chevrolet trucks ever built. They are the most economical Chevrolet trucks ever built. They are the most ruggedly constructed Chevrolet trucks of all time.

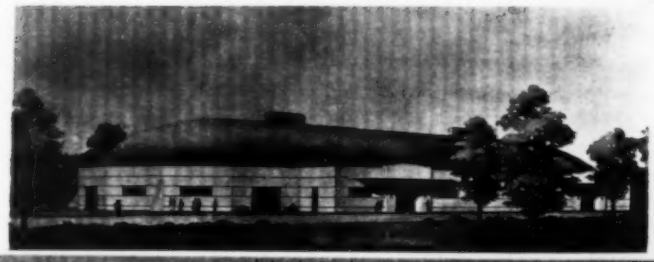
These new Chevrolet trucks are equipped with perfected hydraulic brakes . . . the safest ever developed. The famous Chevrolet high-compression valve-in-head engine develops tremendous power. It performs under all speed and load conditions with remarkable economy. In every feature and detail—frame, axles, springs—there is extra strength, designed for dependable service over an extra long period of time.

You are urged to inspect these new trucks and witness a demonstration of their ability. Compare their size and dimensions and their fitness to do your haulage jobs. And before you select any truck, get the *facts* on operating costs. Find out how and why these new Chevrolet trucks will save you money and increase your operating profit.

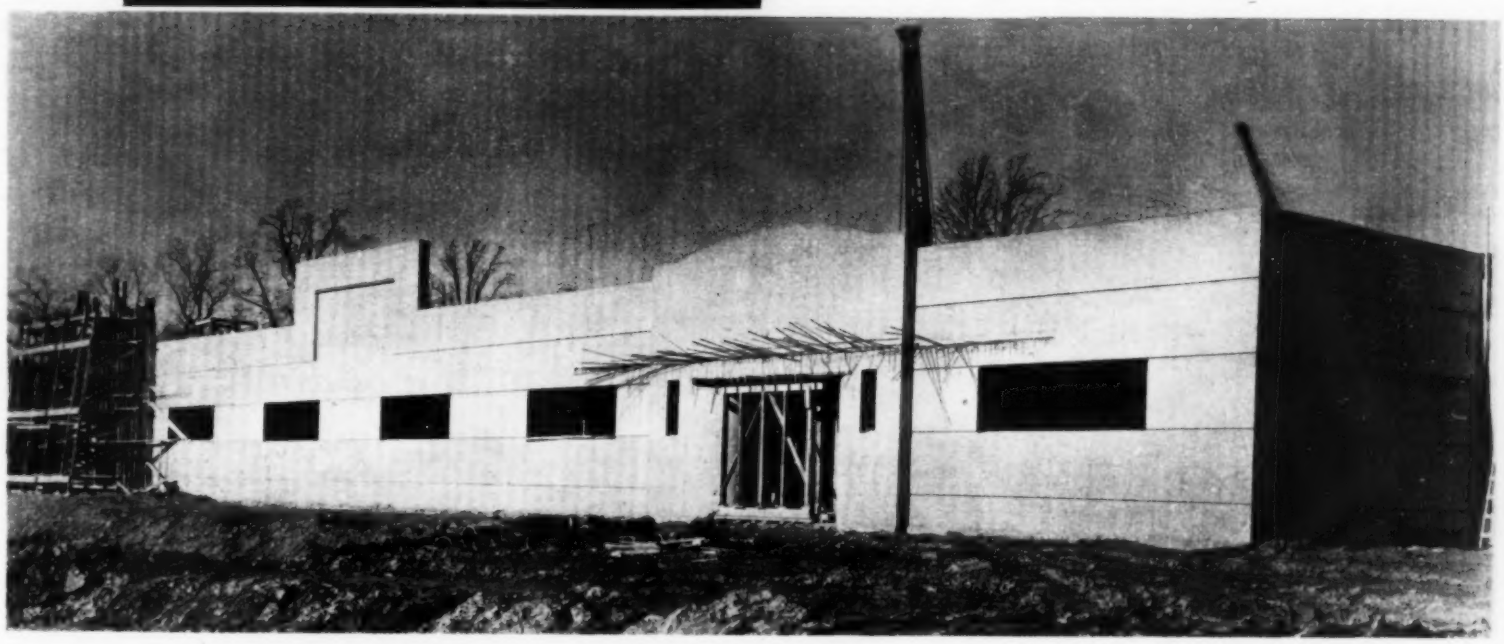
CHEVROLET MOTOR COMPANY, DETROIT, MICHIGAN

6% **NEW GREATLY REDUCED G. M. A. C. TIME PAYMENT PLAN**
The lowest financing cost in G.M.A.C. history. Compare Chevrolet's low delivered prices.

ARCHITECTURAL CONCRETE..



will be considered for the important buildings in your community this year



Here's an example of perfection of concrete wall surface—result of good form-work and careful concrete placing. Swarthmore College Field House, Swarthmore, Pa. Walter T. Karcher and Livingston Smith, architects, Hughes-Foulkrod Company, contractor.

A MAJOR opportunity for contractors familiar with the technique

Consider the possibilities for beauty and economy of casting the whole building—walls, floors, frame, ornament and all—monolithically with enduring, firesafe concrete!

That's just what buyers of new buildings everywhere are doing—last year scores of important commercial buildings, factories, schools, churches and homes were built of architectural concrete.

This year architectural concrete will be selected for many of the new buildings on which you hope to bid. The real buyers of buildings—business executives, public officials and others who have the "say so" on building programs—will be further familiarized with this fast-growing type of construction through national advertising in such papers as *"Fortune"* and *"Business Week."*

When you are called upon to bid on architectural concrete buildings, will you be prepared? The technique is not difficult. Send today for Information Sheets and the new book, *"Forms for Architectural Concrete"*—a 64-page handbook which gets down to brass tacks on problems of equipment, layout, procedure, selection of materials, and details.

Just out—
"Forms for Architectural Concrete."

PORTLAND CEMENT ASSOCIATION
Dept. A2-16, 33 W. Grand Ave., Chicago, Ill.

Please send literature checked:

☐ *"Forms for Architectural Concrete."*
☐ Information sheets on specifications and other details. (AC series, 1 to 12)

Name .....

Company .....

Address .....

City ..... State.....

RED EDGE

KNOWN THE WORLD OVER

MADE of the finest Chrome Nickel Alloy Steel procurable, lighter and trimmer, yet tougher than ever, Red Edge is the largest selling high grade shovel in America.

For years this famous brand has been a consistent repeater with the Buyer, for "Red Edge costs less because it lasts longer."

And with the shoveler it is a great favorite because it makes shoveling easier. There are expert shovelers who wouldn't think of using any shovel, spade or scoop that didn't have the familiar Red Edge.

Every Red Edge Dealer knows the merchandising value of that Red Edge—it's a mark of Highest Quality.

ASK YOUR JOBBER

AMES BALDWIN WYOMING CO.

Parkersburg, W. Va. North Easton, Mass.

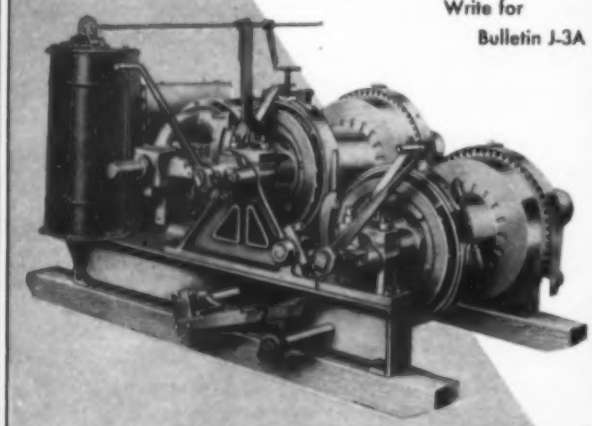
Clyde Electric Hoists

Particularly adapted for handling a derrick, concrete tower work, steel erection, pile driving, in fact for all types of general construction work.

Built in a range of sizes from 5 to 200 horsepower in 1, 2 or 3 drum styles.

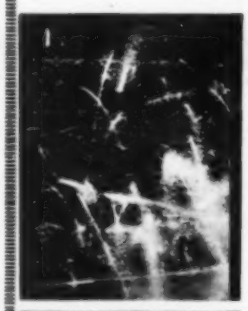
Convenient . . . Clean . . . Economical
Quiet . . . Portable.

Write for Bulletin J-3A

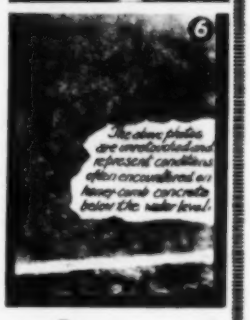


CLYDE SALES CO.
DULUTH - MINN.

WATER-PROOFING with Sika



1 Original surface hacked.
2 Water concentrated to enlarged bleeder holes by Sika #4A.
3 Two bleeder holes plugged by Sika #2. Infiltrations concentrated to bleeders.
4 Inserting Sika #2 into last bleeder hole.
5 All bleeder holes plugged with Sika #2, and rimmed to contour.
6 Protective coat of Sika #1 cement plaster applied.


6
The above photos are unretouched and represent conditions often encountered in heavy cave concrete below the water level.

Use Sika

to stop water inflow through any masonry. Sika mixed with portland cement easily applied by hand — seals off infiltration from underground streams even under pressure.

Write us about your problems

Sika, Inc.
1943 Grand Central Terminal
New York City

1846

90 YEARS

HAZARD WIRE ROPE

1936

When Erskine Hazard started the Hazard Wire Rope Company, back in 1846, there were no such things in general use, as:

Hydraulic dredges
Panama Canal
Power shovels
Boulder Dam
Air compression drills
Traffic tunnels
Stiff legged derricks
Skyscrapers
High speed elevators
Trip hammers
Deep oil wells
High line timber rigs
Airplanes
Automobiles
Tire chains
Asphalt or concrete roads
Electric lights
Telegraph
Telephone
Radio
"Korōdless" (stainless) steel

Hazard wire ropes have helped make many of these things.

HAZARD
WIRE ROPE COMPANY, *Inc.*
Wilkes-Barre, Pennsylvania
An Associate Company of the American Chain Company, Inc.

In Business for Your Safety

District Offices:

New York
Chicago
Philadelphia
Pittsburgh
Ft. Worth
San Francisco
Denver
Los Angeles
Birmingham
Tacoma

GREEN SIGNIFIES SAFETY

LAY-SET *Preformed* Wire Rope

◉ ALL HAZARD WIRE ROPES MADE OF IMPROVED PLOW STEEL ARE IDENTIFIED BY THE GREEN STRAND

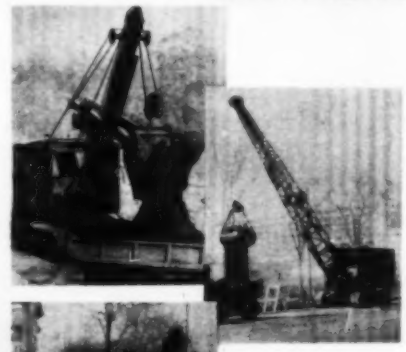
MAKE THIS MONTH COUNT

Are you all set for that new job—the "big break"? Call it New Deal or whatever you want to, there's going to be plenty of dirt flying in the months to come and the important thing is to be ready to handle your share of it.

Don't overlook your equipment—look it "over"! And if it isn't up-to-date—if it isn't the best that money can buy—investigate the "AMERICAN" Line. Behind every unit there is skilled engineering, the best materials and the finest workmanship. Send for our latest catalog today.

AMERICAN HOIST & DERRICK COMPANY

SAINT PAUL, MINNESOTA



AMERICAN Gopher SHOVELS

CRANES · DRAGLINES

TRADE Good Roads MACHINERY MARK

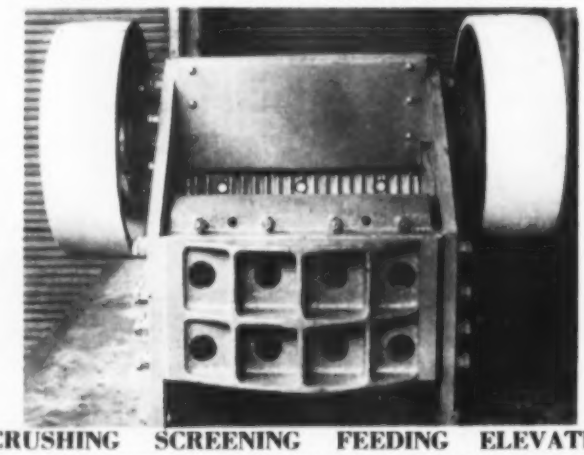
CHAMPION

ROLLER-BEARING ROCK CRUSHERS

Completely Portable

CRUSHING — SIZING — LOADING

PLANTS — FOR STONE OR GRAVEL



CRUSHING SCREENING FEEDING ELEVATING CONVEYING AND WASHING EQUIPMENT

Portable and Stationary plants engineered and built to give desired production requirements

Products of

GOOD ROADS MACHINERY CORP.

"Builders of Rock Crushers for 45 years"

KENNETT SQUARE PENNSYLVANIA

Large Capacity and Portability

are combined

in H&B Tower Type

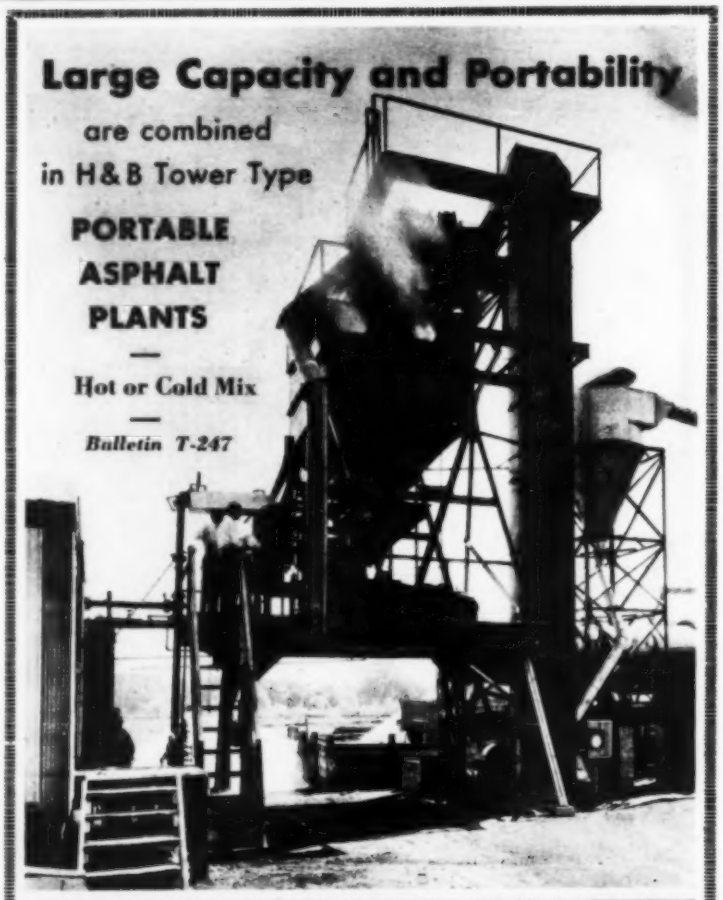
PORTABLE ASPHALT PLANTS

—

Hot or Cold Mix

—

Bulletin T-247

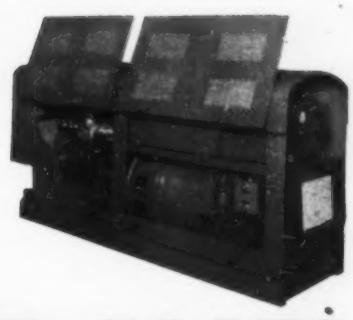


HETHERINGTON & BERNER, Inc.

INDIANAPOLIS, INDIANA

Builders of Asphalt Paving Machinery for over thirty years

Get an IRON GRIP on BRIDGE MAINTENANCE COSTS



WHEN the old bridge "ain't what she used to be" and new steel is specified for its members, look to "*Shield-Arc*" welding if you want bed-rock maintenance costs.

Floor stringers, sub-structures and super-structures can be strengthened to accommodate today's heavy loads. Walks can be moved out to welded-on extensions, permitting wider roadbeds. Everywhere, highway and railroad bridges are being host to the safety and economy of "*Shield-Arc*" reclamation.

Welds are given strength, ductility and corrosion-resistance qualities even superior to mild steel plate.

When you use a "*Shield-Arc*" welder, you save as high as 35 per cent over the operating cost of conventional machines; because when not actually producing an arc, "*Shield-Arc*" idles, reducing fuel consumption.

You can ill afford to delay getting the profit and prestige of "*Shield-Arc*" welding! Ask for particulars today. Mail the coupon to THE LINCOLN ELECTRIC CO., Dept. H-204, CLEVELAND, OHIO. Largest Manufacturers of Arc Welding Equipment in the World.

POP: "'*Shield-Arc*' welding is certainly bridging the gap between limited public funds and the dire need for improvement in bridge structures."

LAD: "This putting-on tool is also saving the day for the contractor in lots of ways—keeping his construction equipment 'on the go'—helping him meet closely-figured schedules."

★ MAIL THIS COUPON TODAY ★

THE LINCOLN ELECTRIC COMPANY
Dept. G-204, Cleveland, Ohio

Gentlemen: Please send complete particulars on the savings possible with "*Shield-Arc*" welding.

Firm _____

Your Name _____ Title _____

Address _____

City _____ State _____

TRUKMIXER BATCHING PLANTS
BULLDOZERS
BLAW-KNOX
STEEL STREET FORMS
DIRTMOVERS
ROAD FORMS
BLAW-KNOX
LEADERSHIP
CONSTRUCTION EQUIPMENT
STEEL FORMS FOR GENERAL CONCRETE CONSTRUCTION
CEMENTGUNS
TAMPING ROLLERS
CENTRAL MIXING PLANTS
CONCRETE BUCKETS
STEEL BUILDINGS
STEEL GRATING
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New developments and improvements in Blaw-Knox Construction Equipment are right in step with today's program.
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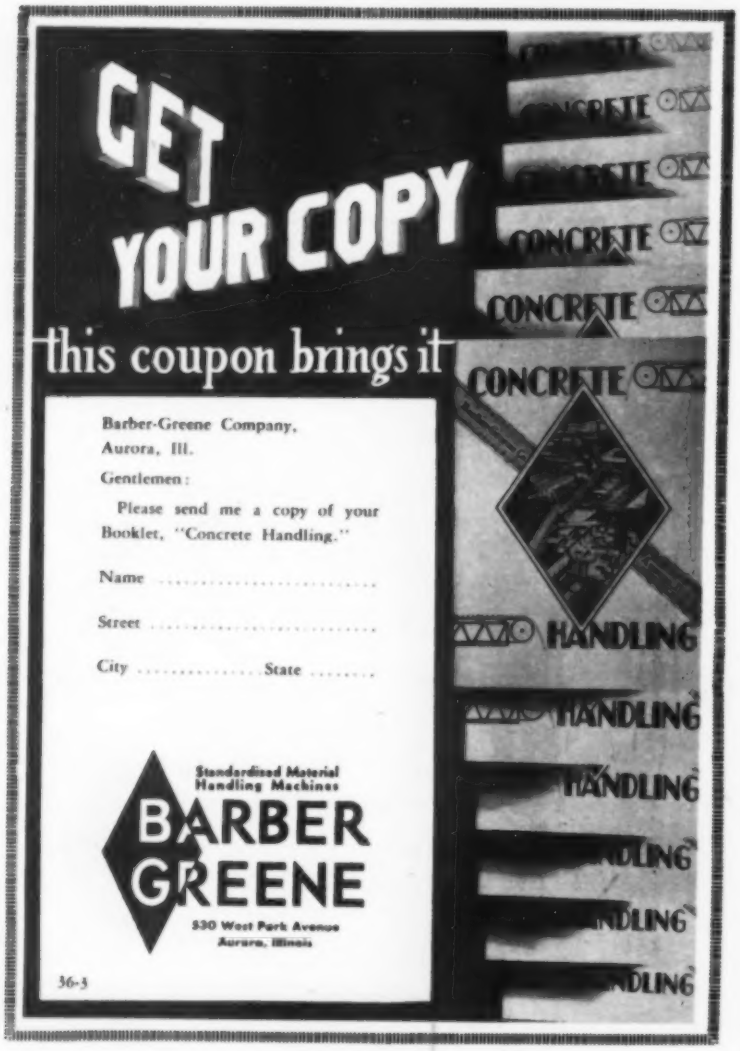
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Slip expansion joint in place, your dowel bars too; then pull the levers to tighten them, carry in place, deposit concrete, release levers, carry to roadside and reload. The whole thing is done in a few moments. The FLEX-PLANE Spotter will pay for itself in a few days. Order yours now.
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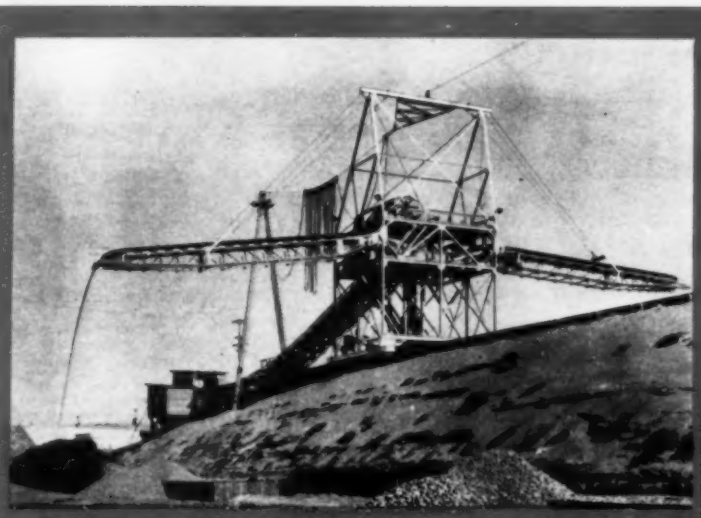
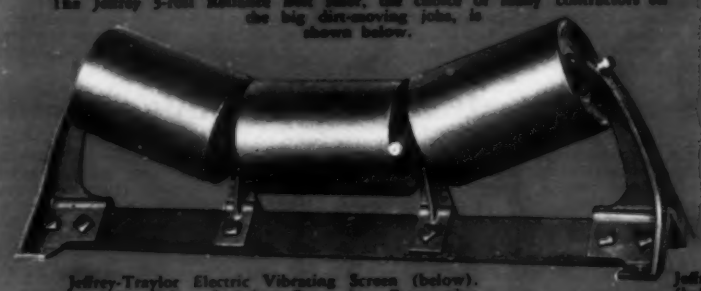


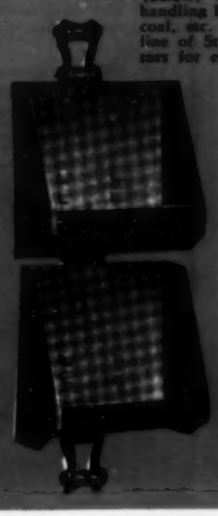
Illustration above shows the ingenious Jeffrey "Airplane Tripper" serving the aggregate plant at Grand Coulee Dam. It straddles the Jeffrey Mixer Storage Conveyor, where it brings the washed and graded aggregate down to the main storage yard. It takes the aggregate from the conveyor and "lays" it on the stock piles with little breakage . . a neat, inexpensive solution to a major problem.

The Jeffrey 3-roll Reliance Belt Idler, the choice of many contractors on the big dirt-moving jobs, is shown below.



Jeffrey-Traylor Electric Vibrating Screen (below). Used for Sizing, Scalping, By-passing, Rescreening and Dedusting, and Washing. Jeffrey Screens embody the patented principal of controlled vibration . . no moving parts — nothing to get out of order. Also Revolving Screens.

Jeffrey Style D Continuous Buckets (below) used very extensively for handling broken stone, sand, gravel, coal, etc. Jeffrey builds a complete line of Standardized Bucket Elevators for every need.



Two of the large 60" Jeffrey Belt Conveyors which were used to rush the dirt at Grand Coulee Dam. Jeffrey Belt Conveyors, using the famous Reliance Idler, are being used in all fields to solve bulk handling problems.

Faster handling . . little or no mechanical trouble . . low cost of operation . . are characteristic of Jeffrey Conveyors, Elevators, Feeders, Screens, Crushers and Portable Loaders, used by Contractors.

On the Grand Coulee job, miles and miles of Jeffrey Belt Conveyors are being used in the world's largest Sand and Gravel Plant. On large, medium and small jobs all over the country . . Jeffrey Belt Conveyors are getting the work done faster . . meeting schedules better . . lowering costs.

Jeffrey builds every type of bulk handling conveyor in addition to the belts. On jobs where the belt does not serve . . there are others available that will. Jeffrey Equipment, because of high grade materials and experienced workmanship, can be counted on to render a complete service in handling the materials of your industry.

Whether it's conveying, elevating, screening, feeding, crushing or pulverizing Jeffrey will do the job with the greatest dependability and economy.

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CARRY THE LOAD

One of the 60" wide Goodall "Super SSS" Brand Conveyor belts at Grand Coulee Dam.

Whether the material is wet or dry, hot or cold, light or heavy, fine or coarse, smooth or abrasive, there is a

GOODALL CONVEYOR BELT TO CARRY THE LOAD,

with a proven record of substantial performance.

- TROUGH READILY
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The use of the right belt assures delivery of the maximum tonnage at the minimum cost.

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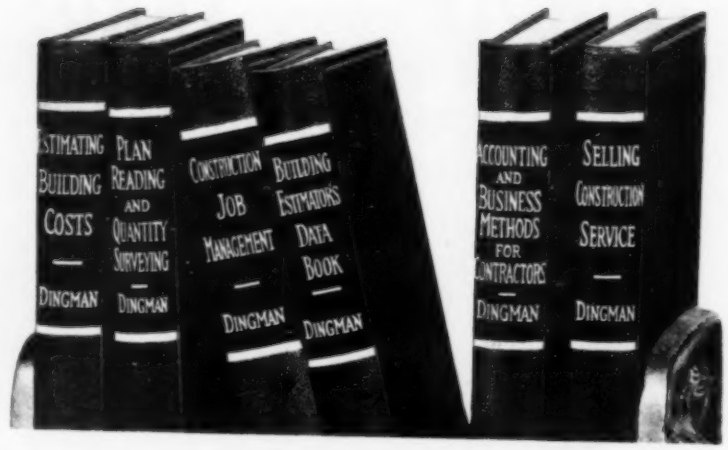

Practical facts on every phase of building construction!

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The Dingman books have won a wide reputation among builders and building contractors for their sound, practical and easy-to-understand discussion of building construction work. All of the material has been drawn from actual practice.

This library is intended for

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[2] The young men in the building industry who intend to make the business of construction their life work, and who want the kind of guidance that will aid them to climb to the top.

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Each one of the volumes in this set is a complete handbook on some important subject. Sturdily bound and pocket size, it will go right "on the job" with you for immediate consultation.

Practical data is given on analyzing a construction job into its component parts—estimating the costs of labor, haulage, equipment, materials, etc.—plan reading and determining quantities from specifications—personnel management—successful supervision of every building operation—efficient and economical business methods—office procedure such as accounting banking, purchasing, etc.—advertising and selling methods for contracting service—and a complete data book of tables, forms and calculations most frequently used by the builder.

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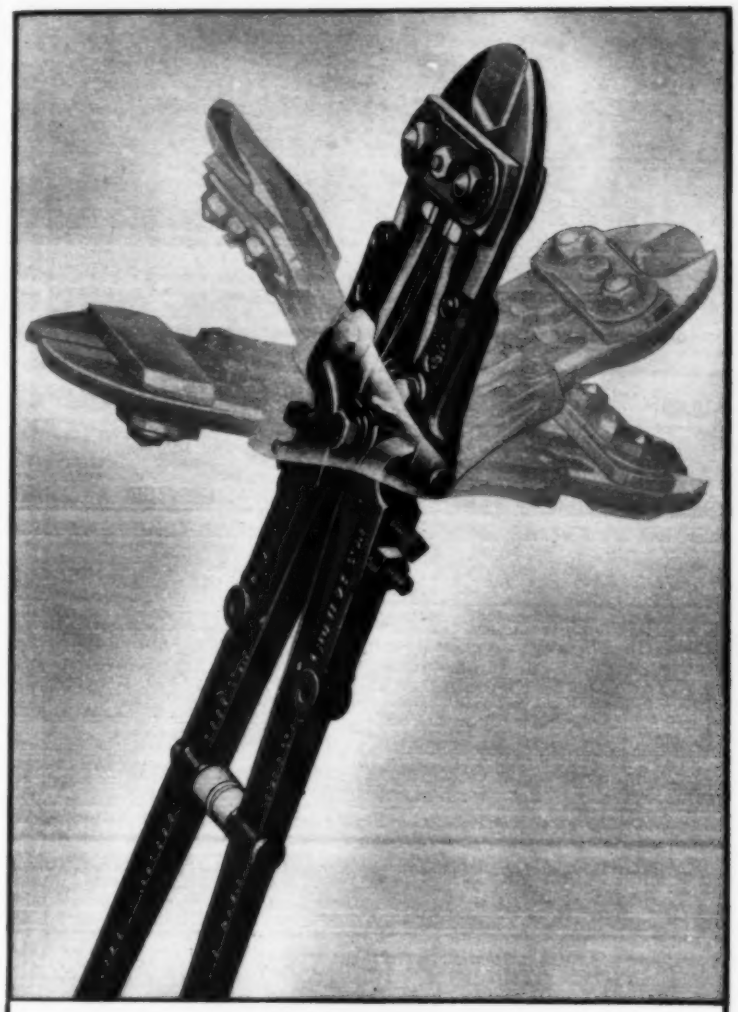

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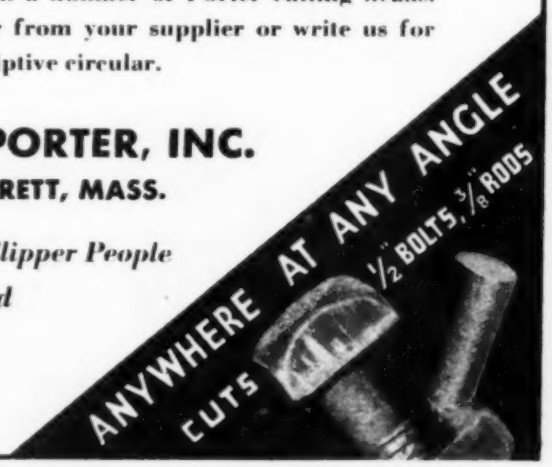

It sticks to the nut till the nut is TIGHT!

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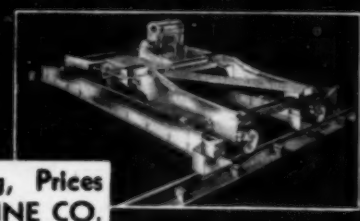

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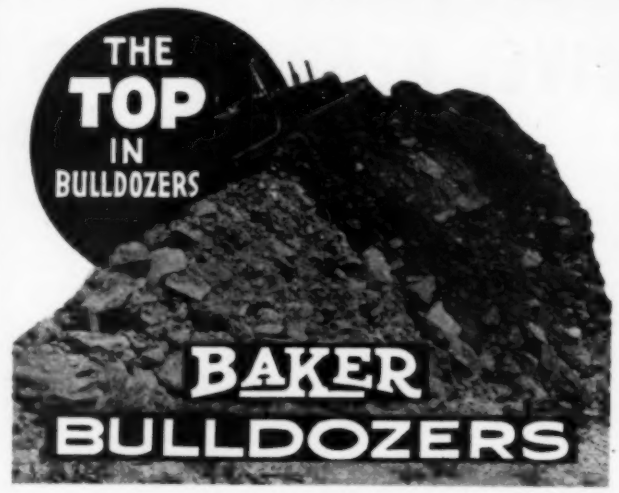

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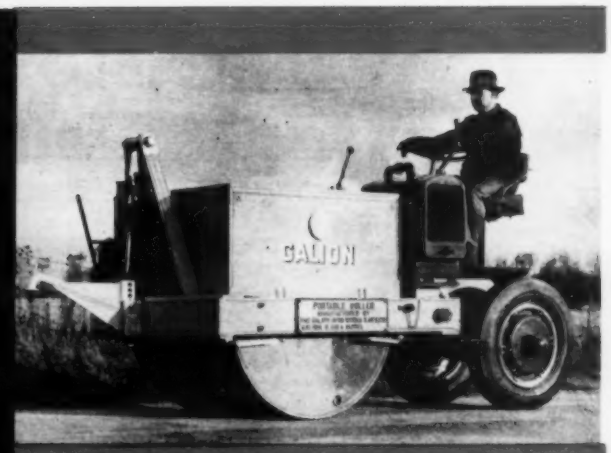
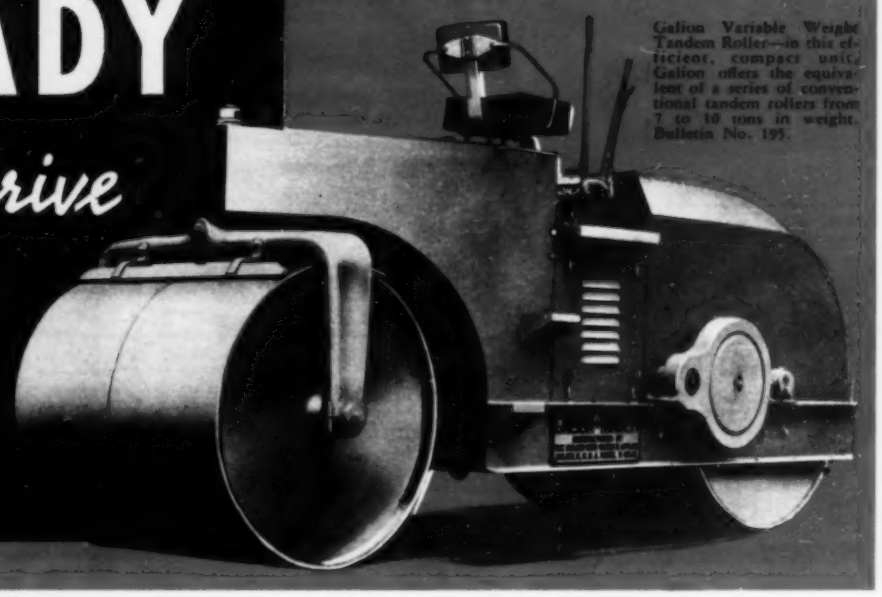
GALION GUARDS ARE READY

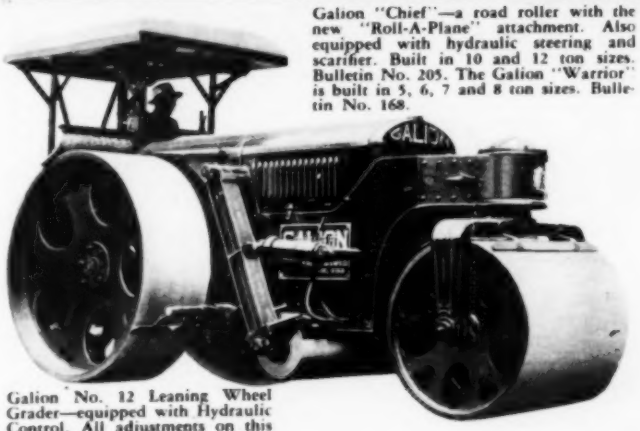
for the big drive of '36



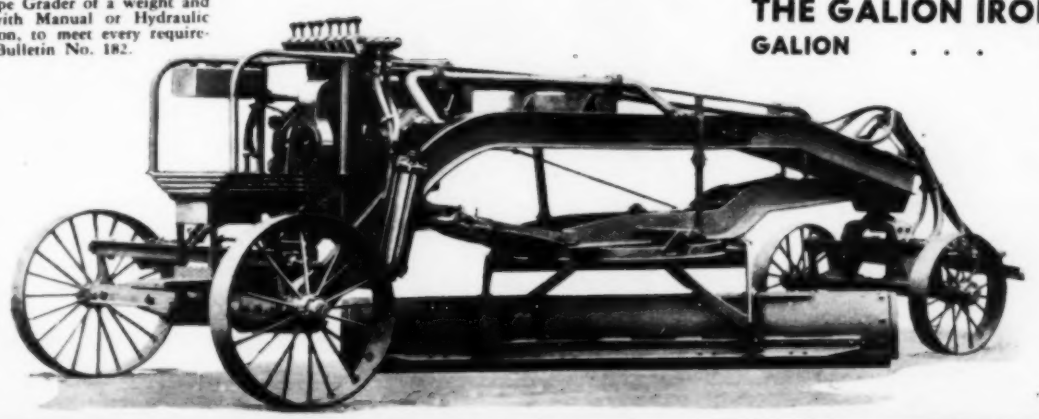
New Galion Portable Roller—a versatile, low-cost machine suitable for rolling patch material, for compacting loose material, rolling drives, etc. Particularly fitted for its portability. Bulletin No. 194.



Galion Variable Weight Tandem Roller—in this efficient, compact unit, Galion offers the equivalent of a series of conventional tandem rollers from 7 to 10 tons in weight. Bulletin No. 195.



Galion "Chief"—a road roller with the new "Roll-A-Plane" attachment. Also equipped with hydraulic steering and scarifier. Built in 10 and 12 ton sizes. Bulletin No. 205. The Galion "Warrior" is built in 5, 6, 7 and 8 ton sizes. Bulletin No. 168.



Galion No. 12 Leaning Wheel Grader—equipped with Hydraulic Control. All adjustments on this big grader are instantly made at the touch of a finger. There is a pull type Grader of a weight and size, with Manual or Hydraulic operation, to meet every requirement. Bulletin No. 182.

Optimism was the keynote of the ARBA at the convention in Cleveland. A concerted drive was planned on new roads, grade crossing elimination, improving old roads, etc.

Galion, always alert and believing a strong attack is the best defense, has its Road Machinery Equipment in the proverbial "pink" for an early annihilation of the common enemy . . . high road building and maintenance costs.

These four Galion Guards shown here are the newest developments in the most efficient, economical and durable road machinery line ever pressed into service. For nearly 30 years, Galion Equipment has been serving State, County and Township highway departments, as well as many leading Contractors . . . not only in the United States but in practically every country throughout the world. Like the Marines, Galion Machines go where needed . . . and serve well.

Our staff of Engineers, with years and years of training, is constantly studying road construction and maintenance problems. Call on Galion.

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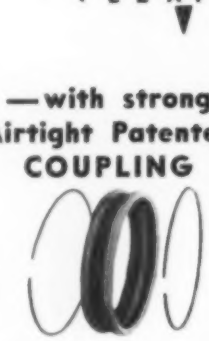
We present the Galion Guards for your inspection:

1. Galion Portable Roller
2. Galion "Variable Weight" Tandem Roller
3. Galion "Chief" Road Roller with "Roll-A-Plane" Attachment
4. Galion No. 12 Leaning Wheel Grader with Hydraulic Control
5. Galion Diesel Powered Motor Patrol Grader (four of these five are illustrated here).

MineVent FLEXIBLE BLOWER PIPE

—with strong Airtight Patented COUPLING



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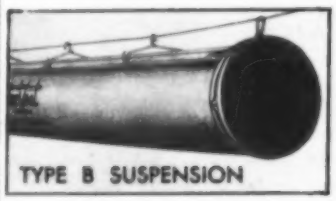

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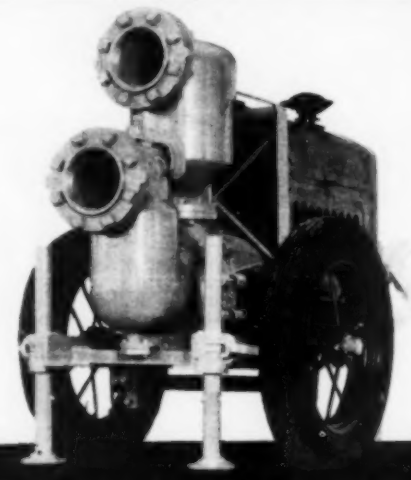

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Johns-Manville offers another Cork Joint... Now Self-Expanding after Installation!

IN THIS TEST at the J-M Research Laboratory, a J-M technician is measuring the ultimate expansion thickness of SE Cork after installation. At his right, is SE Cork in compressed state. The expanded specimen has almost doubled in thickness.

This Amazing Development means that you can now free Old Roads, as Well as New, from Costly Joint Maintenance

SEVERAL years ago Cork Expansion Joint was introduced. With it, ended the need for unsightly joint extrusion on concrete paving . . . and the subsequent damage to the concrete caused by the loss of joint material.

Now comes another advance in the development of the resilient joint: Johns-Manville SE (Self-Expanding) Cork.

For the first time a joint is self-expanding after installation! Think of what this means in terms of low maintenance!

Constantly exerting pressure against the concrete, in an effort to regain thickness, SE Cork assures a permanently tight joint. It fills the slot at all times; foreign matter can never get in to start its work of inevitable destruction.

ACCOMPLISHED BY UNUSUAL PROCESS. During fabrication SE Cork is dehydrated and then precompressed at the factory to approximately 60% of its original thickness. And it *does not regain thickness until moisture is again absorbed.* SE Cork is wrapped in a water-resistant package which is not removed until immediately before installation. Thus expansion takes place only after installation . . . as moisture is taken from the air and concrete. (When installed in wet concrete, SE Cork does not expand until well after the concrete has developed ample strength. When more rapid expansion is desired, direct immersion in water immediately before installation accomplishes it.)

SE Cork provides enduring protection for your concrete roads, streets, curbs and sidewalks—for every type of concrete construction, new or old.

Send for our new brochure on SE Cork Joint. (It contains complete data on Standard Cork Joint, too.) Write to Johns-Manville, 22 E. 40th St., N. Y. C.

ON NEW ROADS . . . Self-expanding after installation, SE Cork will always fill the slot completely. The working range varies from 50% to 140% of the thickness at which the material is installed. By constantly exerting expansion pressure, it fits tightly against the concrete slabs.

Knowing what happens to concrete when foreign materials render expansion joints ineffective—you'll welcome the protection afforded by this non-extruding, permanently tight joint.

ON OLD ROADS . . . In replacing existing materials, SE Cork is the only product with the amazing ability to increase in thickness after installation, and fill the slot at all times.

Replacement work with SE Cork is rapidly accomplished with ordinary labor. By ending joint maintenance and minimizing, too, the pavement repairs so often caused by faulty joint materials, SE Cork over a period of years will prove a better, more economical joint.

Johns-Manville

SE CORK EXPANSION JOINT

Building bridges is a difficult job and one that requires thoroughly tried and proven, fully dependable pumping equipment. That's why Sterling Quality Pumps were selected for this Wyoming job. That's why the largest contractors choose Sterling Quality Pumps.

Get the Sterling habit. Write for catalog and bulletin of engineering data today—it's FREE for the asking.

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The Martin-Decker Shunt Type Cable Tension Indicator simply clamps onto a cable and measures the cable strain with remarkable accuracy. This strong, accurate, portable instrument will supply valuable operating data for the particular cable problem that's troubling you.

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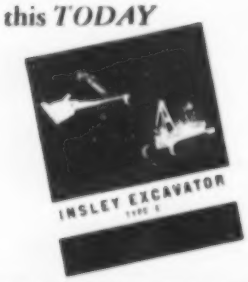
—a new "LOW" in weight, size, price
—a new "HIGH" in PERFORMANCE!

Man, what a tool for the contractor who wants to make *more* profits on *less* money! Weighs only 8 tons—yet does the work of a 12 or 14 ton shovel. On 12 or 15 gallons of gas a 10 hour day, handles from 150 to 400 yds. (depending on conditions), or *loads* 300 to 400 yds. of sand and gravel. Goes anywhere, digs anything. And it's *fast*—3 or 4 passes of its full ⅜ cu. yd. bucket a minute. Its price is *so low* you can't afford to do without it and you can keep it *busy* every minute. You've never seen anything like Type "E"—and remember, it's an INSLEY.

The details are ready—all the facts you want on this versatile, all-round digger, loader and small-pile-driver handler. For E-conomy . . . send for Bulletin on Insley Type "E" today!

Send for this *TODAY*



General Dimensions and Specifications

Full ⅜ yard bucket
Boom length—15′ 6″
Length of Dipper Stick—9′ 6″
270 degree swing
Powered with a Buda 4 cylinder gasoline motor
Overall width—7′ 11″
Working weight—16,000 lbs.

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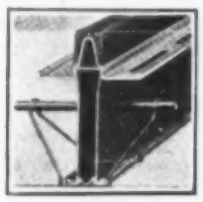
330 West 42nd Street, New York, N. Y.

TIME-TESTED! *Scientific Slab Division for* STRUCTURAL HIGHWAYS



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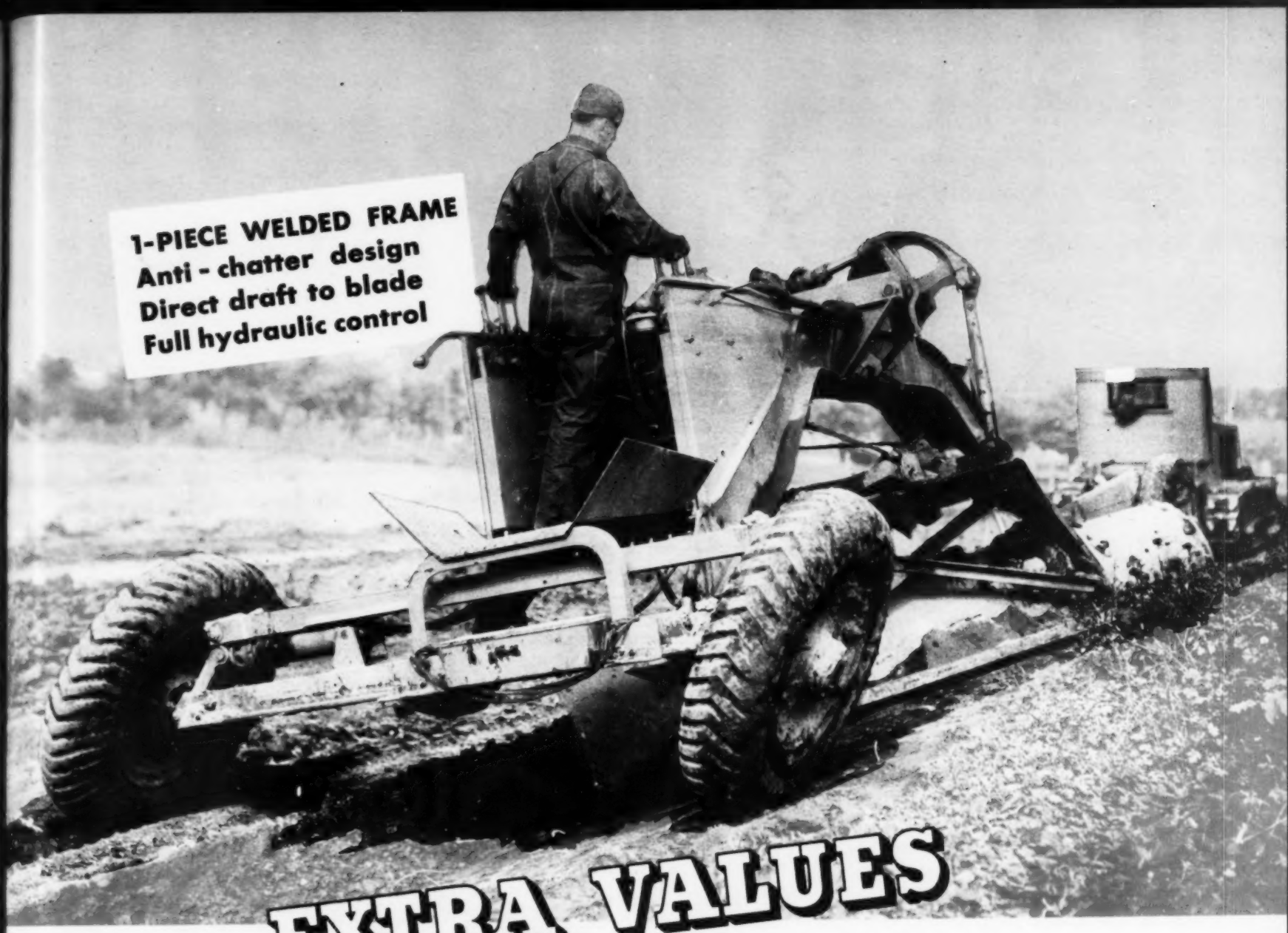

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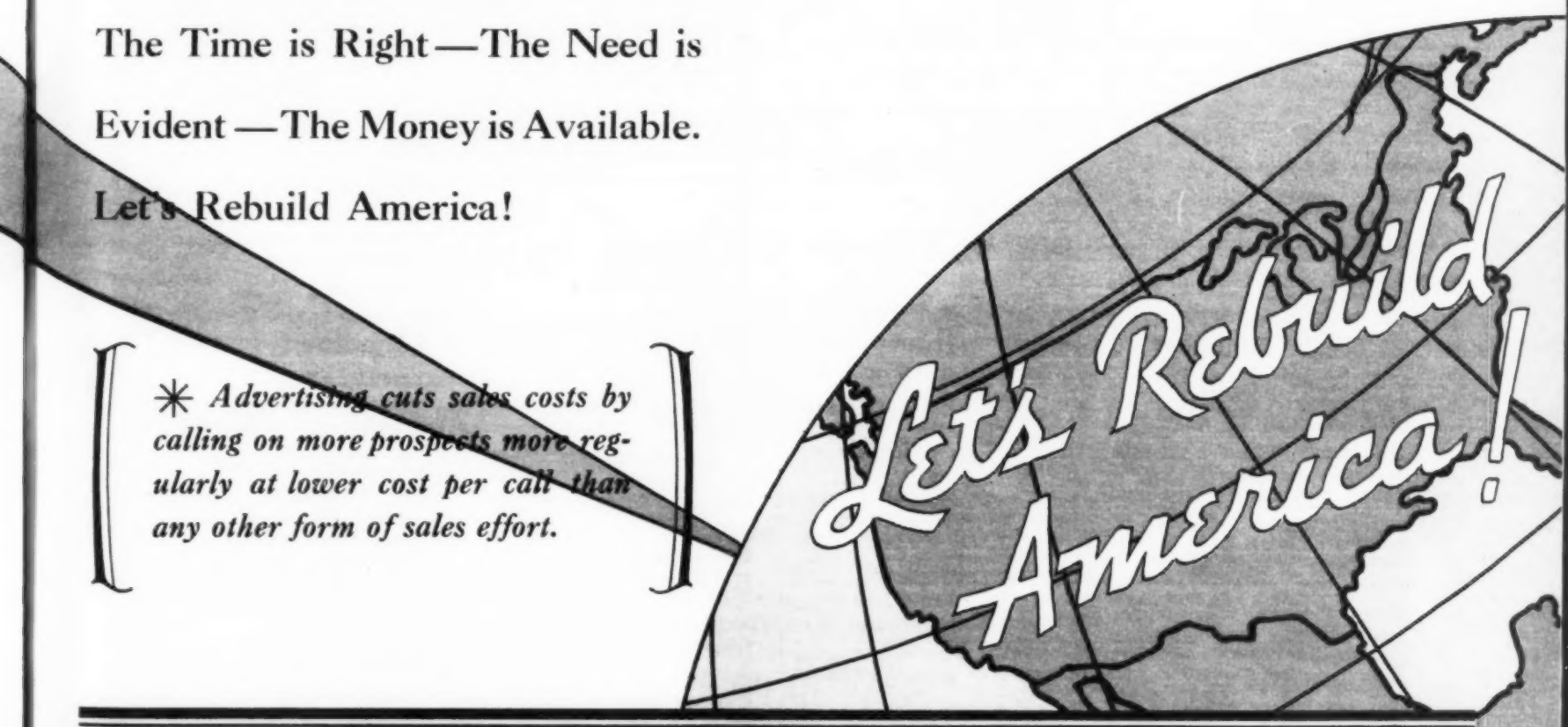

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Mill Supplies
Power
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Radio Retailing
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An index of products made by manufacturers whose advertisements appear in this issue of Construction Methods.

If you do not find all you need in the advertising section, we shall be glad to assist you. Write to—

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330 West 42nd St. New York City

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(Continued on page 86)

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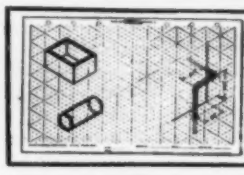
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CONSTRUCTION METHODS
330 West 42nd St. New York City

SEARCHLIGHT SECTION

AT ABSOLUTE AUCTION

Machinery and Equipment of

PATRICK McGOVERN, Inc., Engineers and Contractors

Vernon and Nott Aves., Long Island City, N. Y.; WEDNESDAY, MARCH 4, 1936, at 10 A. M.

By Order of PATRICK McGOVERN, INC. In Liquidation Pursuant to the Direction of the Will of Patrick McGovern, deceased

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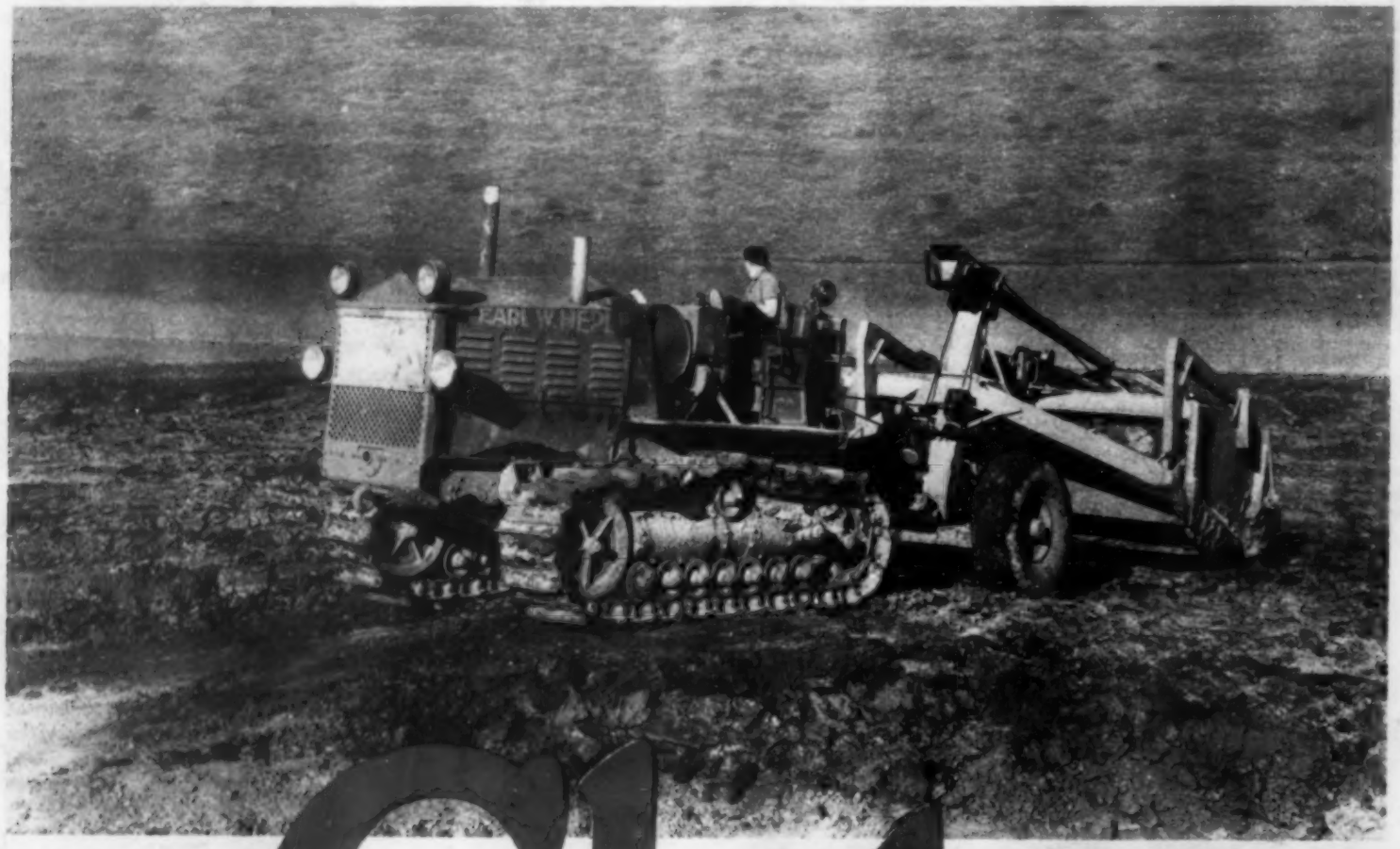

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